

DISTRICT HEATING AND COOLING

HEARING
BEFORE THE
SUBCOMMITTEE ON
ENERGY DEVELOPMENT AND APPLICATIONS
OF THE
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SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
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(III)

DISTRICT HEATING AND COOLING

THURSDAY, JULY 23, 1981

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:40 a.m., in room 2325, Rayburn House Office Building, Hon. Tom Harkin (acting chairman of the subcommittee) presiding.

Present: Representatives Fuqua, Scheuer, Harkin, Volkmer, Sensenbrenner, Skeen, Schneider, and Dunn.

Mr. HARKIN. The Subcommittee on Energy Development and Applications will come to order.

The subject of today's hearing is an energy-saving technology of enormous potential which has thus far contributed little to the Nation's energy needs or to the national energy debate. District heating and cooling systems are basically distribution networks which transport low-temperature waste heat from powerplants, industrial boilers, municipal solid waste facilities, and other renewable energy systems to residential and commercial buildings. They enable low-grade energy which would otherwise be wasted to be used for such tasks as space and water heating.

To give an idea of the significance of this technology, consider the fact that fully 30 percent of the energy consumed by our Nation winds up as waste heat from electric powerplants or industrial facilities—30 percent winds up as waste heat. At least 2 to 5 quads of this energy could be captured by district heating and cooling systems and put to good use in the United States by the year 2000.

In Europe, by contrast, several nations including Sweden and Denmark already derive more than 25 percent of their heating requirements from district heating systems. Considering the sizable potential for this technology, the existing Federal program in district heating seems terribly modest. The Department of Energy spends less than \$2 million a year to assist a few communities to carry out conceptual designs and engineering studies and to put together financing packages.

A few of these projects are now ready to go forward on their own. This spring, HUD and DOE funded 28 communities to carry out feasibility studies as a first step toward implementing district heating systems. An interagency task force chaired by HUD and DOE has been developing a policy paper for a coordinated national effort in this area for more than a year.

This hardly seems like an all-out effort, especially when compared with the West German Government's investment of \$150

million in district heating over the period 1975 to 1980. Moreover, none of the existing activities address the most serious barriers to development of this technology: obtaining the large amounts of capital required for such systems, often as much as \$1 billion, and developing the regulatory and institutional infrastructure needed to allocate costs and benefits.

The question for the EDA Subcommittee is whether we should continue to support the program at DOE, probably against the wishes of this administration, in the absence of an overall program to develop this technology to its full potential. We need to know a number of things.

No. 1, exactly what are the administration's plans for this technology? Do they wish to zero it out? Will they continue any existing programs whatsoever? Will they issue a national policy paper? Will the administration attempt to address the financial and regulatory barriers or will they hide again behind the facade of the "free market"?

No. 2, what other Federal programs or incentives would be needed to insure widespread development of district heating where it is cost effective? Can such programs and incentives be developed in a manner consistent with the new administration's philosophy?

No. 3, if no such programs are forthcoming, Does it make sense to continue the existing DOE effort?

To help us answer these questions, we have invited a number of experts in the field to testify. They will help acquaint us with the technical, economic, financial, and regulatory problems involved in district heating systems. They will also discuss existing national programs and incentives for these technologies, and evaluate the need for further programs, if any.

We begin our hearings with our colleague, Congressman James Oberstar, who will discuss the two district heating bills he has introduced in this session and will review the pioneering efforts of his home State of Minnesota in this area.

Jim, we welcome you to the Energy Development and Applications Subcommittee. My own personal congratulations to you for your leadership in this area and for the bills that you have introduced. I look forward to your testimony. We will place your written statement in its entirety in the record, and please proceed in any manner you so desire.

STATEMENT OF HON. JAMES L. OBERSTAR, A MEMBER OF CONGRESS FROM THE STATE OF MINNESOTA

Mr. OBERSTAR. Thank you very much, Mr. Chairman. My compliments to you for holding this hearing on this very important subject, and to the members of the subcommittee for their interest.

In the late 1940's, as a youngster, I recall people from the city of Buhl, next to my hometown of Chisholm in northern Minnesota, coming back from a trip elsewhere—the southern part of the State of Minnesota—and commenting on the quaint, rustic idea that people had adopted in other parts of the State of building homes with chimneys. "How unusual," they thought, and commented that maybe this was a return to some older period of history, a search for the past.

I puzzled about it, and I recall coming back to Buhl in the wintertime—they were great rivals, the two towns, in sports and in other ways—and it struck me that there was no smoke coming up over the homes because there were no chimneys. Buhl is a city served by central heat, a district heating system, and the people there thought it was rather curious that nobody else was as advanced as they—and also in Mountain Iron, in Virginia, in Hibbing, in numerous other small communities throughout this iron ore mining area of northeastern Minnesota.

I mention that because it struck me as a youngster and the idea stuck with me. Little did I ever think at that time that I would be in the Congress and would sponsor legislation to get the rest of the country to do what northern Minnesota has done so effectively.

The founding fathers of those communities, 70 and 80 years ago, had the wisdom to recognize the financial savings, the convenience, and the reliability of what today we call cogeneration, district heating, and what they called and all of us called city heat—no fancy terms in those days.

The average efficiency of a coal-fired electric generating plant is somewhere around 33 percent but with cogeneration and district heating it can go up to 80 percent efficiency. That was testimony delivered at the hearings that I chaired on behalf of the Northeast/Midwest coalition in St. Paul back in April during our district work period, in which we had some 20 witnesses from throughout the Midwest area, and some from Scandinavia, testifying on district heating.

At those hearings, the city of St. Paul, through Mayor George Latimer, testified that the city will save 8 to 9 million gallons of oil a year through an improved district heating system at 80 percent efficiency. The city is now working on improving that, and I will talk about the details in a moment.

Little wonder, then, with such potential for savings, that the Scandinavian countries where district heating is used extensively—and perhaps where the idea originated for northern Minnesota—have set a goal of achieving 60 percent of their heating requirements to be met through district heating systems. West Germany, which is now underlain by a network of steam piping systems, has set a goal of achieving 25 percent of its heating requirements by the end of this century through district heating systems.

Mr. HARKIN. Where is that, Jim?

Mr. OBERSTAR. West Germany.

Why should the United States, which prides itself on technological achievement, not do what the Scandinavian countries and what West Germany are doing? Here we sit—how appropriate—in this room, surrounded by the marvels of technology—landing a man on the Moon, firing the rockets into space, joining a vehicle in outer space—and we cannot solve the problems of heating on Earth. Therefore, it is ironic, it is very appropriate to have the hearing on this subject conducted in this committee room, by a gentleman I consider to be one of the most progressive, forward-thinking Members of this body.

I want to talk a little about legislation I have introduced for business and residential use of community district heating systems. Preliminary designs for new hot water systems have been devel-

oped in three cities in Minnesota: Moorhead, Red Wing, and St. Paul. They use waste heat from coal-fired powerplants.

Preliminary designs for hot-water heating systems in Moorhead, St. Paul, and Bagley are already underway. The one in St. Paul will begin with a demonstration district heating system in downtown St. Paul, serving all of the government buildings for the State of Minnesota and those for the city of St. Paul. It is a compact area; it has been selected for a demonstration project because there is already some infrastructure in place, and because it is a nucleus that can be expanded to serve the entire St. Paul-Minneapolis downtown and outreach area as well.

It will be the first hot water district heating system technology demonstration in the United States. It is going to cost in the neighborhood of \$70 million. Mayor Latimer testified at our hearings that he expects to generate 270 megawatts of electricity serving the downtown area and the State capitol buildings, and achieving an 80-percent efficiency in the process.

They are doing this with a \$7.7 million UDAG grant and an \$8.5 million grant from the U.S. Department of Energy, and revenue bonds sold by the St. Paul District Heating Co., a private, nonprofit entity.

Mr. HARKIN. Do they have those UDAG grants and DOE grants locked in, Jim?

Mr. OBERSTAR. Yes.

Mr. HARKIN. Do they have the checks written?

Mr. OBERSTAR. Yes, the blood is flowing. Right.

Mr. HARKIN. If it is not, look out.

Mr. OBERSTAR. It was pre-Gramm/Latta II.

Moorhead, which has 30,000 population, out in the western part of the State on the Dakota border, is in one of the coldest areas of Minnesota. They require something like 10,000 degree-days of heating. Energy costs are escalating. They are building a 60- to 100-megawatt system over the next 10 years, and if they can include Fargo, N. Dak., they will go up to 200 megawatts.

They have completed an economic feasibility and design study and are ready to move ahead with final economic evaluation and financing. They expect to begin construction at Moorhead in 1982 and go into service in 1983 with a total estimated investment of \$29 million.

Bagley is a small community in northwestern Minnesota, timber country, dependent on fuel oil for their commercial and residential heating. The costs of energy there, at the end of the pipeline—this is as far away from oil and coal as you can get in the lower 48 States—obviously are extremely high. There is a wood plant in that city that produces a residue waste material that has not been marketable for any purpose. They pile it up and dispose of it in landfills.

They decided that this residue could be burned and used for a district heating system. Therefore, they are going to take waste wood byproduct, burn it, generate steam, generate electricity, heat the community, get two for one.

The Minnesota Department of Energy, our energy agency, has been working closely with Bagley. They have indicated that a district heating system would be competitive with LP gas and with

fuel oil; that they can build a 12-megawatt district heating plant. They already have their final engineering design and feasibility funding from the State of Minnesota and are moving ahead at about a \$4.5 million cost.

In Minnesota, if all communities with the potential for district heating—those with populations of greater than 5,000—could be provided with district heating, we could deliver 44 trillion Btu's a year by the end of this century, which is 3.5 percent of the State's primary energy demand. Sixty percent of that would be cogenerated heat. Now that would mean the saving of 220 million gallons of fuel oil a year. That is not inconsiderable.

The Minnesota State Legislature has not been inactive either on this matter. They have addressed their attention to it. My good friend, State Senator Hubert H. Humphrey III, the son of the late U.S. Senator, has sponsored legislation which has been enacted, signed into law by our former colleague, Gov. Al Quie—so this is not partisan, it is a bipartisan issue—to provide loans and grants to cover up to 90 percent of the planning and construction costs for district heating systems. The bill provides \$50 million in loans for design and construction to pay up to 50 percent of the costs.

Now the legislation that I have introduced would provide \$500 million over a 5-year period in Federal loans for up to 40 percent of the cost of construction or of improving district heating and cooling systems. Those are loans to be repaid at interest rates to be set by the Treasury. Fifty-five million would be available in grants to cover up to 70 percent of the cost of doing the feasibility and design study for a plant.

I have also introduced legislation, as a result of the hearings that we conducted in St. Paul and a subsequent hearing in Washington, to provide a tax credit up to 40 percent for the residential hook up to a district heating system, recognizing the costs that homeowners have in making the connection to a district heating system.

The credit would apply to equipment costs up to \$10,000 and the bill also provides a 15-percent investment tax credit for commercial and industrial hook up to district heating/cooling systems because we recognize that there is a great deal to be gained by involving the private sector.

I would like to take just a moment to review the testimony delivered at our St. Paul hearing conducted on behalf of the Northeast/Midwest Coalition. A range of some 20 witnesses presented testimony which we have boiled down to just a few barebones points.

One, in the financial area it was recommended to broaden the lending authority of the Synthetic Fuels Corporation to include funding of district heating/cooling, municipal solid waste to energy conversion systems. They recommended providing tax-exempt financing for district heating and cooling systems, tax-exempt loans to convert buildings to accommodate such systems, and Federal aid to States for statewide assessments to be made of needs for district heating and cooling.

They recommended preserving loan guarantees for solid waste to energy projects under the Energy Security Act. They supported the legislation I have introduced, and also recommended technical assistance for district heating and cooling through a system of na-

tional laboratories similar to those established in the Scandanavian countries and in West Germany. They recommended coordinating local cogeneration and district heating and cooling systems through Federal agencies. That, again, is based on the European experience of gathering and disseminating information through Government agencies.

Finally, they recommended establishment of a nationwide district heating and cooling effort by accelerating efforts of a group now established, the district heating and cooling interagency work group.

That is just a very brief summary of the hearing. The detailed report is available through the coalition if you would wish to have that.

In summary, Mr. Chairman, it is fashionable to talk about an idea whose time has come. District heating is not an idea whose time has come; it is an idea which has been born again, born of necessity, a child of the energy crunch. I hope that through the hearings this committee is holding and the interest, the public interest that has been generated in this matter, that the Congress will move to act on legislation to encourage district heating systems.

[The prepared statement of Mr. Oberstar follows:]

STATEMENT OF JAMES L. OBERSTAR
JULY 23, 1981
COMMITTEE ON SCIENCE AND TECHNOLOGY

Mr. Chairman, Members of the Subcommittee, I appreciate the invitation to discuss with you an exciting, old energy process that has interested me for quite some time.

District heating and cooling are forms of cogeneration which use the thermal energy by-product of fuel burned to generate electricity. This thermal by-product, usually in the form of hot water or steam, is dispersed through a piping network connecting buildings and residences. It is used to heat water, provide heat and fulfill process steam needs.

District heating can achieve 85-90% fuel efficiency and such systems can be cost-effective in 48 states. By comparison, kinetic energy derived from an electric turbine uses only 30% of the energy potential of a conventional fuel burn. District heating harnesses the remaining by-product which would otherwise be released into the atmosphere or waterways as waste.

District heating and cooling systems have been getting increased attention in these days of energy conservation and appropriate energy technology. Particularly in energy-importing states in the northeast and midwest, district heating provides an attractive alternative to heating homes and businesses where the average energy bill is about \$800.

I represent a district and a state which have been pioneers in America's use of district heating. Minnesota is the home of some of the oldest systems in the Nation. Furthermore, my home area, the Mesabi Iron Range, has some of the largest residential systems in the world. In Virginia, Minnesota, 90 percent of the commercial district and 75 percent of the residential segments are linked to the community's system. It claims the largest number of metered customers of any district heating system in the world.

District heating, like so many other conservation efforts, were derailed, by the decades of cheap oil and gas enjoyed in this country during the post-War decades until 1973. The geometric increases in energy prices in the past seven years have forced a revival of interest throughout the country, in the private and public sectors, in district heating.

At a time when the Administration and Congress are telling America's cities that there will be no funds for new programs, and less money for existing programs, the Subcommittee is appropriately focusing on an energy source that is as old as the century. District heating and cooling are old processes that Congress, state and local governments, and the American people are wisely giving a new look.

I would like to discuss the legislation I have introduced to encourage the development and business and residential use of community district heating systems, and the leadership Minnesota has offered in increasing use of these systems.

Preliminary designs for new hot water cogeneration district systems have been developed in Moorhead, Red Wing and St. Paul/Minneapolis, Minnesota. These systems would use reject heat from coal-fired power plants in the communities. Preliminary designs for hot water district heating systems using waste wood from local industry have been developed in Aitkin and Bagley, Minnesota.

Plans to implement district heating systems in Moorhead, St. Paul and Bagley are underway. I would like to present a brief description of each of these systems as possible prototypes for new district heating systems.

Development of cogeneration district heating in St. Paul/Minneapolis will begin with a demonstration district heating system in St. Paul. This demonstration system will contain all of the elements of a full-scale system, including cogeneration, hot water transmission and distribution, and conversion of heating systems in existing buildings. The area of the city that has been selected for the demonstration system will become the nucleus of an expanded St. Paul/Minneapolis system. It will be the first implementation of hot water district heating technology in the United States.

The \$70 million St. Paul system would generate 270 megawatts and serve the downtown area and the State Capitol Buildings. It may eventually be expanded to residential areas. Cogeneration from a coal-fired power plant near downtown would boost the plant's efficiency from 37 percent to 80 percent. Construction is slated to start late this year, with funding from a \$7.7 million Urban Development Action Grant from the Department of Housing and Urban Development, an \$8.5 million grant from the Department of Energy and \$50 million in revenue bonds sold by the St. Paul District Heating Development Company.

Moorhead, a city of 30,000, located on the western boundary of the State, adjacent to Fargo, North Dakota, is an excellent location to develop a pilot district heating system. Nearly 10,000 degree days of heating are required and energy costs are rapidly increasing.

The system proposed for Moorhead would reach 60-100 MW in ten years. If expanded to include nearby high density loads in Fargo, the system load could grow to 200 MW.

A one year technical and economic feasibility study has just been completed. Engineering design, final economic evaluation and financing are assumed to be completed in 1981. Construction will begin in 1982 with the first year of service in 1983. The total estimated investment is \$29 million.

Bagley, Minnesota is a community of 1650 people located in northwestern Minnesota. The city is totally dependent on fuel oil for both commercial and residential heating, with the obvious and severe economic impact.

Before 1979, a non-marketable wood residue produced by a large sawmill operating in Bagley was either burned or disposed of in landfills. Significant quantities of wood residue are available for use as a fuel. Bagley now plans to use the residue to fuel a hot water district heating system to serve industry, the public school, hospital, commercial district and anticipated industrial expansion.

A preliminary feasibility study conducted by the Minnesota Energy Agency indicated that the project could compete with L.P. gas and fuel oil. The district heating system will be sized for about 12 MW. Funding for final engineering design and feasibility has been tentatively secured from the State. Development costs have been estimated at \$4.5 million.

If district heating were developed in all Minnesota communities with populations greater than 5,000, the total heat delivered by the year 2000 would be 44 trillion BTU's per year. This is about 3.5 percent of the State's targeted primary energy demand in the year 2000. Since about 60 percent of this would be cogenerated, the heat would be produced by fuel also used to generate electricity. The energy saved through cogeneration would be 28 trillion BTU's per year. This is equivalent to 200 million gallons of oil per year.

The difficulty of raising the large initial capital investments that district heating systems demand is a major problem for communities.

A bill recently passed by the Minnesota State Legislature will supply funds for municipal district heating. The bill, sponsored by State Senator Hubert H. Humphrey, will appropriate \$42.4 million for loans and grants that will cover up to 90 percent of planning and construction costs of district heating systems. The bill will also provide \$50 million in loans for design and construction. These would pay up to 50 percent of costs.

The bill complements my bill (H.R. 3205) which would authorize \$500 million over five years in federal loans for 40 percent of the costs of construction or improving district heating and cooling systems and \$55 million in federal grants to cover 70 percent of the costs of feasibility and design studies. I have also introduced (H.R. 3204) to allow 40 percent tax credits on residential equipment to hook-up district heating and cooling systems. The credit applies to equipment costs up to \$10,000. The bill would also provide a 15 percent investment tax credit for commercial or industrial hook-up to a district or cooling system.

Last spring, I chaired an energy agenda hearing held by the Northeast-Midwest Congressional Coalition, in St. Paul, Minnesota. Cogeneration, district heating and cooling and municipal waste-to-energy were the

topics of the hearing. A list of legislative recommendations was proposed to accelerate the use of district heating. Most focused on easing the financial problems of these highly capital intensive technologies. Major recommendations include:

Financial:

- o Broaden lending authority of the Synthetic Fuels Corporation to include funding of district heating and cooling and municipal waste to energy systems.
- o Provide tax exempt financing for district heating and cooling and tax exempt loans for converting buildings to accommodate district heating and cooling systems. Such financing would require revising tax codes and regulations and would encourage investors and consumers.
- o Provide federal aid for states to make state-wide assessments of district heating and cooling needs.
- o Preserve loan guarantees for municipal waste-to-energy projects authorized by the Energy Security Act. The Act's authorization for fiscal years 1981 and 1982 was \$220 million.
- o Pass H.R. 3204 (40 percent tax credits for residential equipment for district heating and cooling) and H.R. 3205 (federal loans and grants for district heating and cooling systems).

Technical:

- o Provide technical assistance for district heating and cooling through national laboratories.
- o Coordinate local cogeneration and district heating and cooling efforts by federal agencies. This may be accomplished by gathering and disseminating information on European district heating systems.

Institutional:

- o Coordinate national district heating and cooling efforts by accelerating the efforts of the District Heating and Cooling Interagency Work Group. (Work Group members come from the Environmental Protection Agency, the Commerce Department Economic Development Administration, the Veterans Administration, and the Departments of Energy, Treasury, Health and Human Services, Defense, and Housing and Urban Development.)

We all have actively supported legislation which encourages the development of viable new sources of energy. In order for the United States to become independent, we must not only decrease our dependency upon foreign oil, but encourage the development of alternative forms of energy as well, such as synthetic fuels and solar energy.

I urge my colleagues to consider a national district heating program - for district heating is not an idea whose time has come, it is an idea whose time has been reborn.

Mr. HARKIN. Thank you very much, Jim.

I am like you. In traveling around my district one winter 7 or 8 years ago, in a small community in my district by the name of Winterset, just about the time the energy bills were starting to go up, I just happen to have been in a small men's clothing store. As a matter of fact, I was buying a suit at the time and we started talking about the energy problem. I said, "Well, I suppose your heating bills have started taking off," and he said, "No, they have not." He said, "We are pretty lucky down here. We get all our heat from the generating plant."

I could not believe it. I never heard of such a thing. I examined it, and you know, all the towns in our area were all built around a square. They built a community generating plant right off the square that generates the town's electricity, and then they pipe the waste heat around the square and heat the buildings the courthouse, of course, which is in the center of the square.

I looked into it more and more. Back during the years of cheap oil their heating bills were not all that low, in comparison. Now they are; now they are really low. They are sitting really pretty down there. All the commercial establishments, of course, pay very little for their heat.

Mr. OBERSTAR. Isn't it marvelous, the greatest progress is with the simplest developments? I am sure it has struck you as it has me: Under our various air pollution programs and water conservation programs we have required the power companies to spend millions, maybe hundreds of millions of dollars to cool the steam that they have spent hundreds of millions of dollars generating—

Mr. HARKIN. Yes.

Mr. OBERSTAR [continuing]. So that they could waste it into the water or into the air. Instead of spending all that money to cool down the steam that they have spent millions of dollars heating up, we could use it to heat homes.

Mr. HARKIN. One last observation: You know, whenever I talk about conservation, people generally get the idea of conservation as, you know, turn down the thermostat, shut off the lights, put on heavy clothes, all that kind of thing, and doing less.

I think the Europeans have the correct idea of conservation. They see it as production; they produce conservation, and they are beating us at our own game. They are making refrigerators better than we do now because they are more energy-efficient. That is conservation. They are doing the things that you suggest, which allow them more internal money for producing other items and goods with which they then flood our markets.

We ought to start looking at conservation as production. We can produce conserved energy. We put people to work. I daresay we can probably reduce pollution. We can capture a lot of waste energy

and save a lot of money doing it. You do not have to turn down thermostats, you do not have to cut down your lifestyle. That is the proper way to start looking at conservation.

Mr. OBERSTAR. I completely agree. Call it efficiency and production rather than conservation, and maybe folks will do it more.

Mr. HARKIN. That is right. That is exactly right.

I appreciate your testimony. I have only one question, Jim, and that is about the tax credits. You said here you propose a tax credit for people hooking up. Do you have any idea what that could cover?

Mr. OBERSTAR. The cost of going from the home to the street.

Mr. HARKIN. To the pipe out there?

Mr. OBERSTAR. Right, to the pipe that would be in the street.

Mr. HARKIN. I see.

Mr. OBERSTAR. Sort of like the house connection for sewers and water.

Mr. HARKIN. I see. You just allow 40 percent.

Thank you very much.

Mr. Chairman?

Mr. FUQUA. Thank you, Mr. Harkin.

I apologize for being late, Jim, but I want to commend you on your testimony and what you have presented to us. We were on a recent trip to Europe and Helsinki, and had a chance to discuss with the Finns the very aggressive program that they have in district heating. It is a part of the world similar to Minnesota. They have very long winters.

Mr. OBERSTAR. I know. Most of my constituents come from there.

Mr. FUQUA. That is right.

Mr. OBERSTAR. A good many of them, anyway, I should say.

Mr. FUQUA. I wish we could take some of that excess steam that we have in Florida from power generation and convert it into cooling. It would be great in the summertime.

You limit your bill to communities of less than 100,000. It seems to me that in larger metropolitan areas with greater concentrations of people, particularly in high-rise apartments and family units, district heating would be a more efficient operation than, say, in a small rural area, and I come from a rural area. However, it seems that the more concentrated the population, the more efficient district heating would be.

Does your bill intend to leave those out, or just——

Mr. OBERSTAR. I do not disagree with that at all. In fact, I totally agree with that but there was the reason that I drafted the bill the way I did. Chicago could swallow up the whole bill; New York could swallow up the entire bill.

Mr. FUQUA. Yes.

Mr. OBERSTAR. I thought that as a demonstration, first-effort program we would have more visible, demonstrable results concentrating on smaller communities where you can have a greater immediate impact on the lives of people. My bill of the last Congress was double this amount for a shorter period of time in these budgetary times, I just scaled down the amount and scaled down the area to which it would apply.

Mr. FUQUA. Of course, a lot of the powerplants you are using as the source for your heat are located in more remote and more

sparsely populated areas rather than adjacent to a metropolitan area. There may be exceptions to that, of course, but generally most of them are sited in more remote areas.

Mr. OBERSTAR. Quite right, and that was a secondary reason for limiting the bill to that size population.

Mr. FUQUA. Thank you very much. I congratulate you again on your testimony and on your legislation.

Mr. OBERSTAR. Thank you, Mr. Chairman.

Mr. HARKIN. Mr. Dunn?

Mr. DUNN. Thank you, Mr. Chairman. I also thank my colleague for his testimony.

One question: I wonder if it would not be a wise expenditure of research dollars, particularly in light of the scope of this committee, to find out how we can make the same system—and there really is not a way right now—to make it a cooling system, too? I recognize your weather conditions in Minnesota but you also do have some summertime weather there.

Mr. OBERSTAR. The bill does provide for district heating and cooling, and the technology exists. I am not able to discuss that in detail but—

Mr. DUNN. No, what I am suggesting is that the cooling technology is not really very good today, Jim, is what I am trying to say.

Mr. OBERSTAR. Yes.

Mr. DUNN. I wonder if we should not be providing some funds to try and upgrade that technology. One of the basic problems of putting the hot water system in is that then the home or the office or the apartment complex, whatever it is, virtually does not have an air conditioning system, and today most of the market is demanding both systems.

Mr. OBERSTAR. Yes. I quite agree, and I think that would be a very wise investment. We should not be myopic or have tunnel vision and focus only on heating requirements. We have to recognize that cooling down the outside heat can be just as important.

Mr. DUNN. The chairman asked the question about 40-percent tax credits for residential equipment. Are you saying that is just for the hook up, or is that for the complete installation of the system in the home?

Mr. OBERSTAR. Installation of system and hook up as well.

Mr. DUNN. Both?

Mr. OBERSTAR. Yes.

Mr. DUNN. I have no other questions.

Mr. HARKIN. Thank you, Mr. Dunn.

Mr. SENSENBRENNER?

Mr. SENSENBRENNER. I have no questions.

Mr. HARKIN. Thank you.

Jim, thank you again for being our leadoff witness and for setting the stage giving us examples of successful projects in Minnesota.

Mr. OBERSTAR. Thank you very much, Mr. Chairman.

Mr. HARKIN. We now move to a panel. I would like to have all of the witnesses come to the table who are on the first panel: Mayor Art Holland of Trenton, N.J., appearing on behalf of the U.S. Conference of Mayors; Norman Taylor, International District Heating Association; Alan Hills, second vice president of Bache, Halsey,

Stuart, Shields, Inc.; and Mary Procter of the energy group of the Office of Technology Assessment. You all have name identification cards there.

There has been a request that CRS be allowed to take pictures of the witnesses. Without objection, it will be allowed.

Our first witness will be Art Holland, Mayor of Trenton, N.J. We would like to go through the entire panel with each of your statements and then open it up for a general discussion, if that would be all right with everyone.

We have copies of your statements, and without objection they will be made a part of the record in their entirety following your oral presentations. If you would care to do so, perhaps it might expedite things if you would summarize your statement and highlight the high points of it and then we can get into a general discussion.

Mayor Holland, if you would be our leadoff on the panel, as I said, you may proceed as you so desire.

**STATEMENT OF MAYOR ART HOLLAND, TRENTON, N.J., ON
BEHALF OF THE U.S. CONFERENCE OF MAYORS**

Mayor HOLLAND. Mr. Chairman, Mr. Acting Chairman, fellow panelists, ladies and gentlemen, I want first to comment on Congressman Oberstar's presentation. I think it was a very dramatic one.

We have just issued a brochure in connection with our cogeneration project and, had I known of that example which showed one community with no chimneys, I certainly would have wanted to include that opposite a community with houses showing chimneys. That is, I think, the most dramatic demonstration of the value of central heating.

You have a copy of my statement which is in behalf of the U.S. Conference of Mayors. Part of that is the Trenton experience. I would like to substitute for the Trenton experience space as listed in my overall U.S. Conference statement, a supplemental statement on the Trenton Integrated Community Energy System because I think its detail will be educational, and I hope impressive.

[Material referred to follows:]

TRENTON INTEGRATED COMMUNITY ENERGY SYSTEM (ICES)

The Trenton Integrated Community Energy System (ICES) offers an alternative method of supplying both electric power and thermal energy at the same time in a process commonly referred to as "cogeneration". What makes the Trenton Cogeneration Project especially unique is that the thermal energy will become part of a district heating energy system to provide hot water in and around the downtown area. This will be the first such district heating system constructed in the United States since the 1920's.

The cogeneration process is a far more efficient energy producing process than by conventional means. It is estimated that the Trenton system will produce fuel savings of about 40%, resulting in about five million fewer gallons of oil consumed annually.

Crucial to the ICES development in Trenton has been federal assistance through the Departments of Energy and Housing and Urban Development. The City of Trenton received a \$4 million Urban Development Action Grant from HUD and about a \$400,000 Demonstration Grant from DOE to help finance the \$23 million cost of the Trenton project. Also critical to the project's success was tax exempt bond financing through the New Jersey Economic Development Authority.

Trenton sees the ICES project as an important incentive to spur downtown development. Due to the availability of a

district heating system, developers do not need to purchase and amortize expensive heating plants, nor do they have to set aside portions of building space for such plants.

The district heating system will serve various customers of high temperature hot water, initially including the State of New Jersey to heat eleven existing office buildings including the State House, the County of Mercer to heat its Court House and Detention Center, the City of Trenton to heat a proposed civic center, Mercer Medical Center, a privately-owned office building, and several apartment buildings. Additional customers can, of course, be added to the system in the areas served by the project.

The ICES plant itself will consist of approximately 12 megawatts capacity of medium-speed diesel engines, plus supplementary and conventionally fired boilers. The diesel engine will have dual-fuel capability, that is they can burn both natural gas and fuel oil. This dual fuel feature will allow ICES to use an interruptible gas supply and curtail natural gas during the coldest weather. This feature also allows ICES to use synthetic and refuse derived fuels as they become available in the future.

The diesel engines are cooled with a jacket of cooling water, just as an automobile engine is cooled; however, instead of dissipating the heat to the atmosphere, which is accomplished by a car's radiator and fan, the heat is extracted from the cooling water and used. In addition the hot exhaust gases, which in a

conventional internal combustion engine are exhausted to the atmosphere, are utilized in a heat recovery unit which in turn produces high temperature hot water.

This is the technology which will be found inside the ICES plant, which will combine to co-produce both 26,000 volt electrical power and 350° F high temperature, superheated water. The electrical energy will flow in the transmission and distribution system of the utility grid. The high temperature hot water will flow through underground highly insulated pipes where it will be distributed to customer buildings.

The high temperature hot water will arrive at the customer's building where it will be converted to a variety of forms depending on the end-use equipment and requirements particular to the building. In most cases, in the Trenton system, the water will be either flashed to steam, or used directly as hot water. This thermal energy will heat buildings, operate absorption air conditioning systems, sterilize hospital and laboratory equipment and run laundries.

Statement by Mayor Arthur J. Holland, City of Trenton, New Jersey, in supplement to his statement on behalf of The United States Conference of Mayors on District Heating/Cooling and the Cities before the Subcommittee on Energy Development and Applications Committee on Science and Technology U.S. House of Representatives.

July 23, 1981

Mr. HOLLAND. First, the Conference is grateful to the committee for convening these hearings on Federal district heating and cooling programs. We are glad to see that this important energy source is receiving the attention that its potential merits.

The Trenton Integrated Energy System, ICES, offers an alternative method of supplying both electric power and thermal energy at the same time in a process commonly referred to as cogeneration. What makes the Trenton cogeneration project especially unique is that the thermal energy will become part of a district heating energy system to provide hot water in and around the downtown area. This will be the first such district heating system constructed in the United States since the 1920's.

The cogeneration process is a far more efficient energy-producing process than by conventional means. It is estimated that the Trenton system will produce fuel savings of about 40 percent, resulting in about 5 million fewer gallons of oil consumed annually.

Crucial to the ICES development in Trenton has been Federal assistance through the Departments of Energy and Housing and Urban Development. The city of Trenton received a \$4 million urban development action grant from HUD and about a \$400,000 demonstration grant from DOE to help finance the \$23 million cost of the Trenton project. Also critical to the project's success was tax-exempt bond financing through the New Jersey Economic Development Authority.

Trenton sees the ICES project as an important incentive to spur downtown development. Due to the availability of a district heating system, developers do not need to purchase and amortize expensive heating plants, nor do they have to set aside portions of building space for such plants.

The district heating system will serve various customers of high-temperature hot water, initially including the State of New Jersey—we are the State capital—to heat 11 existing office buildings, including the State House; the county of Mercer to heat its courthouse and detention center; the city of Trenton to heat a proposed civic center; Mercer medical center; a privately owned office building; and several apartment buildings.

Additional customers can, of course, be added to the system in the area served by the project. Interestingly, we are about to lose—unless in some last-minute way we can save it—our central YMCA. What has broken the back of the Y, and this is happening in other old, central cities, has been utility costs. If we had cogeneration right now it could save our YMCA, in my opinion, and if we can keep the Y going, as we build cogeneration in Trenton we will be able to extend those pipes to the Y.

The ICES plant itself will consist of approximately 12 megawatt capacity of medium-speed diesel engines, plus supplementary and conventionally fired boilers. The diesel engines will have dual fuel capability, that is, they can burn both natural gas and fuel oil. This dual fuel feature will allow ICES to use an interruptible gas supply and curtail natural gas during the coldest weather. This feature also allows ICES to use synthetic and refuse-derived fuels as they become available in the future.

We are upgrading our sewage treatment plant to tertiary level now. We are supplying bins for sewage from three surrounding

municipalities. We intend to recycle that sewage into pasteurized pellets which will be one of the fuels for our cogeneration plant.

The diesel engines are cooled with a jacket of cooling water, just as an automobile engine is cooled. However, instead of dissipating the heat to the atmosphere, which is accomplished by a car's radiator and fan, the heat is extracted from the cooling water and used. In addition, the hot exhaust gases, which in a conventional internal combustion engine are exhausted to the atmosphere, are utilized in a heat recovery unit which in turn produces high-temperature hot water.

This is the technology which will be found inside the ICES plant, which will combine to coproduce both 26,000-volt electrical power and 350° F high-temperature, superheated water. The electrical energy will flow in the transmission and distribution system of the utility grid. The high-temperature hot water will flow through underground, highly insulated pipes, where it will be distributed to customer buildings. We are hoping that this will also be a means of getting rid of snow and ice on our sidewalks in the downtown area.

The high-temperature hot water will arrive at the customer's building, where it will be converted to a variety of forms depending on the end-use equipment and requirements particular to the building. In most cases in the Trenton system the water will be either flashed to steam or used directly as hot water. This thermal energy will heat buildings, operate absorption air conditioning systems, sterilize hospital and laboratory equipment, and run laundries.

I am not alone in this. Mayors across the country are enthusiastic about district heating and cooling. Over 110 cities responded to HUD's request for proposals in its district heating assessment program, and a record crowd of city officials came out on a hot Sunday afternoon to attend a traveling workshop on district heating in Louisville during the recent U.S. conference annual meeting.

That policy has provided the backdrop for the conference to actively acquaint mayors and their staffs with the technology and the potential for district heating/cooling. In May, the conference sponsored a trip to Germany, Denmark, and Sweden to observe different financing and operating approaches. Mayors on that trip were deeply impressed, returning convinced that district heating and cooling can work in this country if given a chance.

Mr. Chairman, we have an extremely large untapped energy resource in our cities, namely, the waste heat from a variety of sources including municipal trash, industrial facilities, powerplants, solar, and geothermal heat. City government will have to play a central role, in conjunction with private businesses and other levels of government, in the development of this resource through district heating and cooling systems.

This is necessary because local government is the only institution in the city able to bring together all the actors that must be a part of a district heating and cooling project. Only local government has the ability to lower the cost of financing these systems through techniques such as tax-free bonds, which could make a difference in the economic feasibility of a district heating and cooling project.

Energy is a national as well as a local issue. There is a genuine Federal responsibility for the development of district heating and cooling. A key guideline for the Federal role comes from the experi-

ence of the mayors who traveled to Europe: Start small and keep things simple. Successful systems are those which are simple, reliable, and relatively inexpensive.

Secondly, the various Federal programs should be aimed at facilitating the operation of the financial markets where most of the decisions about investment in district heating and cooling systems will be made. Several different types of Federal programs can help to reduce both the perceived and real risks for such investors. A recent Conference of Mayors study group, a summary of which is attached, determined that these include:

INFORMATION

District heating may be a proven technology in Europe but its association with decaying steam systems in people's minds in this country causes many investors to shy away. The Federal Government could help a great deal if it were to translate much of the information it already had into a form that was usable by investors. In effect, the Federal Government needs to play a role analogous to the investment analysts that proliferate on Wall Street to produce information for large institutional investors.

I think it is appropriate to note at this point that there is one piece missing in our Trenton project. Originally DOE was to allow \$200,000 to \$250,000 for an information center, a visitors' center, in connection with the project. This has been taken back. It would seem to me, especially with the renewed interest and the feasibility studies that will be undertaken in some 26 cities across the country, that it would be important to have such a center to which those studying feasibility could come and witness a plant in operation. We expect to break ground right after Labor Day.

Therefore, I would hope that this committee would support our request to DOE for that additional, relatively small amount, so that we could maximize the potential educationally—and thus lead to more implementation of the idea—through our project.

REGULATORY REVISIONS

Earlier this spring the Conference of Mayors convened a gathering of experts to discuss the specific regulatory environment affecting district heating and cooling. In general, they agreed that present energy regulations were not designed with district heating in mind. As a result, there are a number of instances in which perfectly reasonable regulations turn out to be serious discouragements to potential investors.

The Fuel Use Act, for example, can significantly increase the cost of a system using natural gas because, even though it may serve high-priority customers such as residences, Government buildings, or hospitals, it is treated as an industrial user and must pay the highest prices for the fuel.

RESEARCH AND DEVELOPMENT

Except for installations on several military bases, district heating and cooling is virtually unknown and untried in this country. This means there are quite a number of technical, economic, and institutional questions surrounding the application of hot water district

heating in this country, and all of these help to keep investors cautious. Their cautiousness will be reduced as Federal research and development programs demonstrate the feasibility of the technology.

FINANCIAL ASSISTANCE

We are at a point in the development of district heating and cooling systems in this country where it is appropriate to take a careful look at how the individual systems can be developed and what mix of financial support, private and public, Federal, State, and local, is appropriate.

Several fine approaches have been proposed which would provide some form of support for district heating and cooling. Foremost among these is Representative Oberstar's bill which would provide assistance to municipal utilities in smaller communities. The conference considers this a good beginning but we think Congress needs to expand consideration to the full range of heat sources and to all cities.

The bill cosponsored by Senator Wallop and Representative Heftel extending tax benefits to industrial cogenerators should help district heating as well but, again, it is only one component of what we think should be a more comprehensive approach to district heating and cooling.

Finally, the International District Heating and Cooling Association is at work on the outlines of a broader bill that relies on several different tax incentives for utilities, private district heating system developers, and customers to cover some of the cost of hookups. In final form these ideas will deserve careful attention.

What is needed, really, is a national district heating/cooling policy. The Conference wishes to offer four points which would define the basic elements of a national district heating and cooling strategy: There should be an investor-oriented research and development strategy designed to reduce risks felt by potential investors. There should be a series of financial incentives, not exclusively tax credits, to utilities, private industry, and potential customers for a finite period of time. This financial assistance should be designed to lower the cost of constructing the first stages of what can later become self-supporting and self-financing systems.

There should also be a system of incentives to local governments to plan for and initiate district heating and cooling systems, including matching grants, loans, and perhaps even some form of bonus payments for energy production that displaces imported oil.

Finally, there should be an exploration of amending the Synthetic Fuels Corp. charter to allow it to finance district heating and cooling systems. The Synthetic Fuels Corp. was initially established to support development of new technologies which would allow the country to make better use of our tremendous resources in coal, oil shale, and tar sands. If district heating and cooling can be a lower-cost and more rapid means of substituting domestic energy resources for imported oil, it deserves to be included among those technologies that the corporation is subsidizing.

I can think of no more important matter before this Nation than reducing our reliance on imports, so this matter—and I sense this committee so considers it—deserves the highest attention. It is my

hope that through hearings such as this it will continue to receive that attention.

Again, we want to thank you, Mr. Chairman, for letting the Conference present its views, and I appreciate the opportunity to give the experience in our own city.

[The prepared statements of Mayor Holland follow:]



UNITED STATES CONFERENCE OF MAYORS

1620 EYE STREET, NORTHWEST
WASHINGTON, D.C. 20006
TELEPHONE: (202) 293-7330

STATEMENT OF

THE HONORABLE ARTHUR J. HOLLAND
MAYOR, CITY OF TRENTON

on behalf of

THE UNITED STATES CONFERENCE OF MAYORS

on

DISTRICT HEATING/COOLING AND THE CITIES

before the

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

July 23, 1981

Mr. Chairman, and members of the Subcommittee, I am Arthur J. Holland, Mayor, the City of Trenton. I am here today on behalf of the U.S. Conference of Mayors, which is composed of the nation's principal cities.

The Conference is grateful to the Committee for convening these hearings on federal district heating and cooling programs. We are glad to see that this important energy source is receiving the attention that its potential merits.

THE TRENTON EXPERIENCE

District heating is extremely important in my own city of Trenton. We are currently working with a private entrepreneur to build a cogeneration system producing electricity and hot water to serve the downtown area. The potential service area contains 18 commercial and highrise residential structures with a combined total of 3 million square feet of floor area. Along with thermal service, the developer, expects to sell power to the utility grid to support the cost of the entire system, a total annual savings of 5 million barrels.

The district heating system, with its ability to offer reliable supplies of heat at prices which should remain relatively stable, is an important element of business retention and development in our downtown area.

District heating in Trenton is based on experience in public-private partnerships acquired in our earlier community and economic development projects. The private

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developer has received support from the city, the state, and the federal government. The Department of Energy's research and development funds, and the Department of Housing and Urban Development's Urban Development Action Grant were both crucial to this project.

DISTRICT HEATING/COOLING AND CITIES

Mayors across the country are enthusiastic about district heating and cooling. Over 110 cities responded to HUD's request for proposals in its district heating assessment program, and a record crowd of city officials came out on a hot Sunday afternoon to attend a travelling workshop on district heating in Louisville during the Conference's recent annual meeting. That policy has provided the backdrop for the Conference to actively acquaint mayors and their staffs with the technology, and the potential for district heating/cooling. In May, the Conference sponsored a trip to Germany, Denmark and Sweden to observe different financing and operating approaches. Mayors on that trip were deeply impressed, returning convinced that district heating and cooling can work in this country if given a chance.

Mr. Chairman, we have an extremely large, untapped energy resource in our cities, namely the waste heat from a variety of sources including municipal trash, industrial waste heat, waste from power plants, solar and geothermal heat.

City government will have to play a central role in conjunction with private businesses and other levels of government in the development of this resource through district heating and cooling systems. This is necessary because local government is the only institution in the city able to bring together all the actors that must be a part of a district heating and cooling project, only local government has the ability to lower the cost of financing these systems through techniques such as tax-free bonds which could make the difference in the economic feasibility of a district heating and cooling project.

THE FEDERAL ROLE

Energy is a national as well as a local issue. There is a genuine federal responsibility in the development of district heating and cooling.

A key guideline for the federal role comes from the experience of the mayors who traveled to Europe: start small and keep things simple. Successful systems are those which are simple, reliable, and relatively inexpensive.

Secondly, the various federal programs should be aimed at facilitating the operation of the financial markets where most of the decisions about investment in district heating and cooling systems will be made.

Several different types of federal programs can help to reduce both the perceived and real risks for such investors.

A recent Conference of Mayors study group, determined that these include:

Information: District heating may be a proven technology in Europe, but its association with decaying steam systems in peoples' minds in this country causes many investors to shy away. The federal government could help a great deal if it were to translate much of the information it already had into a form that was useable by investors. In effect, the federal government needs to play a role analogous to the investment analysts that proliferate on Wall Street who produce information for large institutional investors.

Regulatory Revisions: Earlier this spring the Conference of Mayors convened a gathering of experts to discuss the specific regulatory environment affecting district heating and cooling. In general, they agreed that present energy regulations were not designed with district heating in mind. As a result there are a number of instances in which perfectly reasonable regulations turn out to be serious discouragements to potential investors. The Fuel Use Act, for example, can significantly increase the cost of a system using natural gas, because, even though it may serve high priority customers such as residences, government buildings, or hospitals, it is treated as an industrial user, and must pay the highest prices for the fuel.

Research and Development: Except for installations on several military bases, hot water district heating and cooling is virtually unknown and untried in this country.

This means there are quite a number of technical, economic and institutional questions surrounding the application of hot water district heating in this country, and all of these help to keep investors cautious. Their cautiousness will be reduced as federal research and development programs demonstrate the feasibility of the technology.

Financial Assistance: We are at a point in the development of district heating and cooling systems in this country where it is appropriate to take a careful look at how the individual systems can be developed, and what mix of financial support--private and public; and federal, state, and local is appropriate.

Several fine approaches have been proposed which would provide some form of support for district heating and cooling. Foremost among these is Representative Obestar's bill which would provide assistance to municipal utilities in smaller communities. The Conference considers this a good beginning, but we think Congress needs to expand consideration to all cities and to the full range of heat sources and distribution systems.

The bill co-sponsored by Senator Wallop and Representative Heftel, extending tax benefits to industrial cogenerators, could help district heating as well, if it included piping and end user retrofit which we think would be a more

comprehensive approach to district heating and cooling.

Finally, the International District Heating and Cooling Association is at work on the outlines of a broader bill that relies on several different tax incentives for utilities, private district heating system developers, and customers to cover some of the cost of hookups. In final form these ideas will deserve careful attention.

TOWARD A NATIONAL DISTRICT HEATING/COOLING POLICY

. The Conference wishes to offer four points which would define the basic elements of a national district heating and cooling strategy.

- There should be an investor oriented research and development strategy, designed to reduce risks felt by potential investors.

- There should be a series of financial incentives, and not exclusively tax credits, to utilities, private industry, and potential customers for a finite period of time. This financial assistance should be designed to lower the cost of constructing the first stages of what can later become self-supporting and self-financing systems.

- There should also be a system of incentives to local governments to plan for and initiate district heating and cooling systems, including matching grants, loans, and perhaps even some form of bonus payments for energy production that displaces imported oil.

● There should be an exploration of the possibility of amending the Synthetic Fuels Corporation Charter to allow it to finance district heating and cooling systems. The Synthetic Fuels Corporation was initially established to support development of new technologies which would allow the country to make better use of our tremendous resources in coal, oil, shale, and tar sands. If district heating and cooling can be a lower cost and more rapid means of substituting domestic energy resources for imported oil it deserves to be included among those technologies that the Corporation is subsidizing.

Mr. Chairman, the U. S. Conference of Mayors appreciates the opportunity to present our views to you this morning. We would be glad to answer any questions you have.

RESOLUTIONS ADOPTED

Forty-Eighth Annual Conference
Seattle, Washington
June 7-11, 1980



UNITED STATES
CONFERENCE OF MAYORS

**Support for an Energy
Policy on District Heating**

WHEREAS, the conservation of energy has become a top priority of the Administration and the U.S. Conference of Mayors; and

WHEREAS, over the years there has been a deterioration of district heating systems in the urban areas of the United States to the point of abandonment or the consideration of abandonment by the parent utility companies; and

WHEREAS, energy charges generated by electricity or gas enjoy the advantage of tax-exempt financing under the Internal Revenue Code and applicable regulations, but district heating (steam and hot water) facilities cannot be financed by industrial revenue tax-exempt bonds; and

WHEREAS, district heating provides a method for energy conservation that has been successfully used throughout Europe for many years and should be promoted by the Federal Government in cities of the United States; and

WHEREAS, the U.S. Conference of Mayors commends the Department of Housing and Urban Development and the Department of Energy for recognizing this problem and initiating a policy in this area,

NOW, THEREFORE, BE IT RESOLVED that the U.S. Conference of Mayors urges the White House and the Congress to recognize the potential of district heating as a mode of energy conservation and to further encourage the Department of Housing and Urban Development, Department of Commerce and Department of Energy to promote and provide funding for the development of new and the rehabilitation of existing district heating systems; and

BE IT FURTHER RESOLVED that the U.S. Conference of Mayors urges the Congress to amend Section 103(s)(4)(E) of the Internal Revenue Service Code to include district heating (steam and hot water); and

BE IT FURTHER RESOLVED that the U.S. Conference of Mayors urges the Administration and the Congress to adopt a National District Heating Policy as part of the National Urban Policy. Such a policy should:

- provide the basis for resolving or removing regulatory, fiscal or legal barriers and impediments to the rehabilitation and/or construction of district heating systems;
- provide positive incentives for the establishment and maintenance of district heating (and potentially district cooling) systems in America's cities; and
- provide for the efficient coordination of all federal, state and local resources toward these objectives, including but not limited to the loan- and grant-making regulatory and assistance-providing capacities of HUD, DOE, DOC, EPA and the Federal Laboratories.

Mr. HARKIN. Thank you very much, Mayor Holland, for your excellent testimony.

We now turn to Mr. Norman Taylor of the International District Heating Association. Mr. Taylor, again, your statement in its entirety will be made a part of the record. Please proceed as you so desire.

**STATEMENT OF NORMAN R. TAYLOR, EXECUTIVE DIRECTOR,
INTERNATIONAL DISTRICT HEATING ASSOCIATION**

Mr. TAYLOR. Thank you, Mr. Chairman.

To tell you a little bit about IDHA, the International District Heating Association, and about my part in that, I spent some 40 years in the utilities. The IDHA is composed of some 50 utilities in the United States, and about 50 institutions that use district heating for their own use. Therefore, I speak to you from the utility perspective.

One of the jobs of IDHA when it was formed in 1909—one of our oldest trade associations—was to educate, to share experiences, to try to bring the industry into focus across the country. I think we have done a good job of education because our members seem to have educated Congressman Oberstar to the point that he has not left me very much in the way of a statement.

IDHA is affiliated with similar groups throughout the world. We know what is happening overseas. We know, too, that district heating works; we have had that experience. We know that it is a simple technology. We can prove that it is environmentally acceptable. We know that it has a versatility to utilize many different types of fuels. We know, too, that district heating has the best potential to use productively much of the energy that we now waste.

We know that this is a business that can employ substantial numbers of people, people with moderate skills, and could employ them where they live because district heating is a business that is in the core of cities.

District heating systems do not intrude; they are hidden below the ground. District heating systems are not hazardous. They use standard materials that are readily produced in the United States.

An important factor, though, is that district heating could do a great deal in helping to stabilize cities where we are experiencing the flight of industry and commerce to more kind climates.

IDHA is enthusiastic about district heating but so is much of the world. We heard about Europe but let me tell you about another country that came to our attention: Japan. Since 1971, Japan has embarked on a district heating and cooling program. At the present time there are some 30 district heating/cooling projects under-way throughout Japan.

They point very proudly to a new project in Tokyo that will heat and cool 13 high-rise buildings to be built in a new commercial center. They believe this may be one of the largest projects of its kind in the world.

We know well that Russia has the largest, most extensive district heating of probably any country.

Where is the United States? Where do we stand? Sales in the 50 utilities that report to IDHA have declined steadily. They fell 4

percent in 1980, they fell 9 percent in 1979. District heating accounts for less than 1 percent of U.S. energy use for heating and cooling.

Why, then, the extremes between the United States and the rest of the world? There are parts of the world that have similar climate and similar living standards. Let's look at some of the reasons.

The utilities built the U.S. district heating systems. They built them around a system of utilizing waste steam from in-city plants. Europe and Japan, some 50 years later, based their systems largely upon hot water, a later evolving technology.

It would be oversimplification, however, to blame our lack of progress only on the difference that we use steam and they use hot water. U.S. district heating was developed around low-priced, ample supplies of fuels and available sources of good water at low cost.

There is no shortage of fuels to the utilities in the United States today. If I were a utility executive and I wanted oil, a simple telephone call would have the tankers lined up at my dock ready to dump it into our tanks. The only problem is one of cost. The European countries and Japan seem to have more concerns relative to supply as well as the concerns with price.

U.S. electric plants are, as has been stated, about 30 percent efficient. Seventy percent of the dollars that we spend for fuel are wasted. Europe achieves as high as 85 percent efficiency. Why does that occur and what are some of the reasons in back of it?

Basically, in utility operations fuel cost is passed on to the customer. There is no real incentive to reduce those costs. There is no reward for greatly increasing the efficiency.

District heating has been assisted by governments in other countries, but it has not been greatly boosted through U.S. efforts. In the U.S. district heating is a private sector business and always has been.

Some of the efforts that have been made in Europe to boost district heating were encouragement of hookups: that is, when the district heating system went by the particular area, there were some concessions made to get the customer to hook up. There were advantages given to the utility in regard to right-of-way, and to the opening of streets. These do not exist in the United States.

Another factor is that Europe, very early in the game, looked at the problems of solid waste disposal in its cities. They built plants and they were successful in utilizing the heat from the incineration of solid waste to supply their district heating systems. Here in the United States we have barely scratched the surface of that technology.

There is a fantastic amount of industrial waste in the United States, wasted heat. We have done very little to tap this resource. It can be done. It does not expend additional fuel and it makes district heating a very practical means of utilizing what we now throw away.

U.S. utilities, gas or electric, make good profits from their business. These people are good business people. They do not want to promote a low-profit, competitive business without some real reason. They have to have some demonstration.

Utilities are strange people. They have fallen on hard times in the past few years. Their capital dollars are hard to come by. They are ultraconservative. They will tend to follow more than lead. They have had many difficulties with regulatory problems, and I always quote one that may be of interest to you.

In a nearby district heating utility, there were two very large Federal buildings to be built. They were within range of a good, working, active, profitmaking district heating system. One building could be fed from that system, but for the other one, the utility did not have enough capacity.

As a result they said, "That is no problem. We will put in another boiler and by putting in another boiler we can feed the large Federal building." The cost of that boiler was probably \$8 million.

That utility could not get permission to install a boiler, to make an addition to an existing district heating system, to basically supply a Federal building. Before I left that utility, the mechanical engineer of the building that was under construction called, and he said, "Tell me for the last time, you are not going to be able to supply me with district heating."

"No; we are not."

That meant that that facility was going to put in about \$5 million worth of boiler plant, oil-fired, with engineers around the clock, a million gallons of oil in storage in the middle of a city, trucks that will truck the oil into that building continually.

The only way that that utility could have done anything to get a boiler able to supply that facility would be to go through a rehearing process, to look possibly to coal in the center-city area. That time frame was not conducive to getting the building built.

The other part was cost. If we had gone to a coal-fired boiler to feed the district heating system with the technology of just a few years ago, the cost base would have raised the rates throughout that whole system to where district heating would have been prohibitive. Therefore, we have some problems within that whole area that are constraining district heating.

What do we need? One thing we need to do is some regulatory reform. The utilities in the district heating business have been scrutinized, and criticized. They are afraid to move in any area because of what may happen regulatory-wise.

We need some tax relief in district heating. There are inequitable parts of the tax law that favor the business that has a gas-fired or an oil-fired boiler on its premises as compared to the district heating company which wants to supply steam or hot water. IDHA will sponsor a tax reform bill related to district heating. We expect to do this by the fall of this year. Certainly, gentlemen, I would ask you to support this, if you will, and give it your every consideration.

I said that utilities tend to follow rather than lead. They need examples. They need demonstrations, and I would ask that you consider demonstration projects, consider the feasibility studies that we have been engaged in. It is true, district heating is a known, proven, technology but there are some new ways of doing things. We cannot lift exactly what is being done in Finland or in Sweden or in West Germany or in Japan and put it in downtown

Washington. We do want to develop American products to be used in these areas.

I think we need some way to reward efficiency. I think we need a framework where we do something for the utility that improves its efficiency from 30 percent to 70 or 80 percent by using cogeneration, which engages in a cooperative effort with a trash-burning facility, or some way improves the efficiency on the local level of utilizing fuel.

I think there is another important thing. I think we need to define some goals and some objectives and we need to do it on a national scale. If these goals are well-defined and they are reasonable, our utility people will follow them. They are good business people and they are also good citizens.

Thank you.

[The prepared statement of Mr. Taylor follows:]

INTERNATIONAL DISTRICT HEATING

ASSOCIATION

1735 EYE ST. N.W. SUITE 611
WASHINGTON, D.C. 20006
202/223-2922

Subject: Statement of the International District Heating Association to the Subcommittee on Energy Development and Application. Subject: "District Heating and Cooling: Current Status and Future Prospects."

By: Norman R. Taylor, Executive Director, International District Heating Association, 1735 Eye Street N.W., Suite 611, Washington, D.C. 20006

District heating and cooling is a method of transmitting energy for doing work. The heating or cooling of a structure, the application of heat to a process, are examples of work. A shaft transmitted the capacity for doing work from the early water wheel but as the distance became greater and the needs more complex, better means of transmission were required. Electric power is one way of transmitting the capacity for doing work over long distances, and district heating is another.

In 1877 an American named Birdsill Holly determined that each building in his community need not have its own heating plant, store its supply of fuel, or use the labor to maintain the fire, but that one central boiler plant could do these things by transmitting thermal energy via steam to the various locations. He invented district heating.

District heating as conceived by Mr. Holly and as practiced throughout the world today is a simple technology using conventional materials. The skills to install and maintain systems are modest, transferable, and their pay scales are reasonable. The systems are enduring with most components having an expected service life of more than 40 years. DHC systems are not hazardous to the public, are environmentally acceptable, and their technology is proven.

The progress of district heating in Europe is impressive and it is on-going. In Sweden 60% of the heating demand is expected to be met by district heating in the year 2000. West Germany has a goal of 25% in the same time frame, and France is catching up by providing grants for 15% of new system costs. Russia is, by far, the leader in the use of district heating, reports indicating 70 times the capacity of all U.S. systems combined.

Japan has installed considerable district heating service as indicated in a report from the Japan Heat Service Utilities Association. There are 30 undertakings listed, all having been started after 1971 with considerable district cooling supply included. Japan claims that the district heating and cooling system for a new Tokyo Metropolitan Center of 13 skyscrapers will be the world's largest project of its kind.

In the U.S. the major heating/cooling companies have reported their statistics to the International District Heating Association for more than 70 years.

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A copy of some essential statistics are addended to this statement. Significant is that sales in 1980 are 4% below 1979, and 1979 sales were 9% below 1978. In 24 cities 270 customers discontinued the use of district heating service. Of these, 3.3% converted to the use of oil, 72.6% converted to natural gas, 12.6% converted to electric heating, 10% were unspecified as to the alternate fuel, and 1.9% were establishments no longer in business. In comparison to the losses, 59 new customers were added in 22 cities. Total reported U.S. customers were 13,142 in 1980.

Characteristically, the U.S. district heating company is a property of an electric, gas, or combination utility. Heat distribution is by means of steam and 8 companies have chilled water sales. Customer owned steam powered air conditioning equipment was reported in 10 cities, and this use increased 2.4% over that reported in 1979. District heating fuel sources in the U.S. for 1980 were approximately 12% from coal, 16% from natural gas, 27% from cogeneration (turbine topping) and 45% from oil.

Why has Europe and recently Japan been able to build, operate, and enthusiastically support district heating while the industry has declined steadily in the U.S. There are some essential differences. The systems in Europe and Japan have been more recently developed and have selected hot water as a general method of energy transmission thus differing substantially from the basic steam distribution used in this country. Hot water has the advantages of lower transmission losses, greater effective distance, it avoids the loss of treated water, and is generally less costly to install. However, it is limited to space heating, low level process applications, and has no potential in regard to air conditioning. Steam distribution in the U.S. started when electric generating plants were near to the central city and could supply the heating needs of buildings, power air conditioning machines, machinery, and provide process heat for industry. For a variety of reasons U.S. electric generating facilities moved from the central city leaving much of the district heating supply to single purpose steam production plants. At about the same time the process steam using industries were tending to move to suburban locations relegating the district heating systems to the supply of offices, commercial buildings and multi-family structures, all having relatively poor load factors; that is, the hours of thermal requirement per year was quite low. It is, therefore, over simplification to blame the poor position of DHC in the U.S. on the single point of the use of steam as opposed to Europe's hot water. Studies indicate that to merely modify the systems so as to be based on hot water would not make district heating attractive in the utility marketplace. The cost of retrofit in U.S. buildings now designed for steam to hot water would be so high that use, and even continuation of business at the location, may be discouraging.

In the U.S. there is no shortage of fuel. A telephone call would have a string of tankers scrambling to unload at the utility's dock. A good contract will have the gas pipeline running a pipeline at a mile a day to reach an industry. Barring strikes, coal is available in such quantities that ships line the Chesapeake Bay awaiting loading for other countries. The problem is cost of the fuel. District heating cannot be effective when the utility must use the same fuel at relatively the same cost as the customer. Consider the tax

Page 3

advantages of the customer owned boiler plant as opposed to the tax and regulatory burden of the utility and the stalled position of district heating becomes quite apparent.

District heating and cooling need not be stalled in the U.S., in fact to move this proven technology to a pace matching that in countries with a similar standard of living would do far more than provide a convenient method of heating and cooling urban structures.

- The average U.S. electric generating plant using fossil fuels is about 30% efficient, 70% of the cost of fuel is wasted. District heating could raise the efficiency to at least 75%—a considerable savings in basic fuel expense.
- District heating can be supplied from a variety of fuels whereas the customer who buys and operates his own plant is limited in type of fuel and subject to market changes.
- District heating construction can be a significant factor in improving employment as it is a center city project, is labor intensive and uses a variety of off-the-shelf U.S. products, particularly in the metals and construction materials industries.
- District heating can allow better control of air quality. The utility's few burning facilities can be well monitored whereas the multiplicity of stacks, resulting from individual plants, cannot. Additionally, the vast amount of fuel stored and transported within the city is greatly reduced when district heating systems are in use.
- In the national interest, district heating, if effectively marketed, could save 450 million barrels of oil per year by the year 2005. This is based on converting just 10% of the residential, commercial and industrial energy consumers to district heating that uses fuel sources such as coal, urban waste, cogeneration with electric power, or waste heat recovery from industrial processes.
- At the local level, district heating could make the inner city more attractive for business. Flight of industry from northern sites is not only disastrous from the city's tax base viewpoint, but employment markets and the inventory of skills is diminished in a compounding fashion. Space conditioning costs are important factors in the location decisions of U.S. corporations.

Noting the advantages to the U.S. national objectives of the utilization of district heating and cooling, what are the constraints to its advancement and how may more widespread adoption of this technology be advanced? District heating and cooling in the U.S. is largely a utility business having been built and operated in that private sector. The utility industry is conservative, its capital funds are hard earned, their moves are criticized and scrutinized, there is often more of a tendency to follow than to lead, and they have an obligation to a very broad spectrum of the population to keep energy supplies and costs equitable. District heating and cooling can also be a local government service, a cooperative venture, or a private business, but the problems, concerns and constraints are very similar. To achieve its full cost effective



Page 4

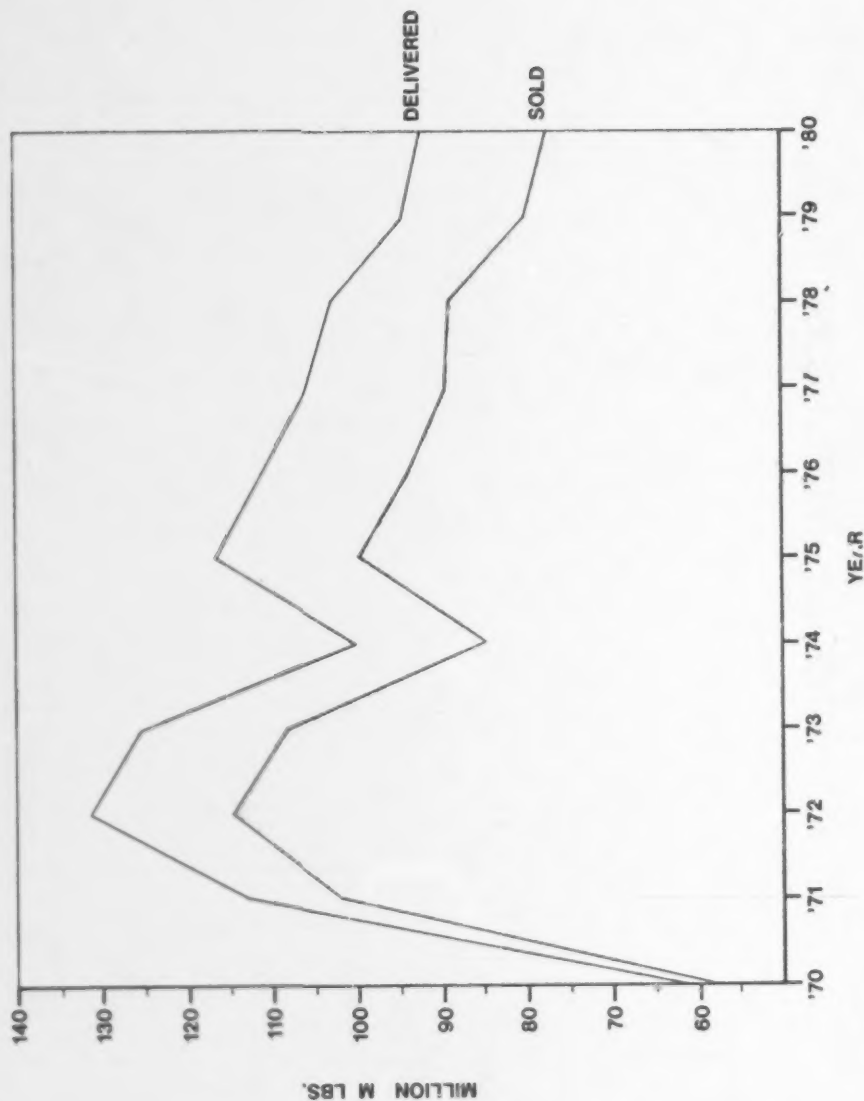
potential energy efficient contribution programs and incentives will be necessary, and those must readily identified and feasible include:

- Regulatory reform to allow recovery of investment on a par with non-utility types of enterprise. Additionally, to eliminate discriminatory practices with regard to cogeneration, fuel use, environmental controls, and siting of facilities.
- Feasibility and demonstration. If the feasibility of district heating and cooling is reliably determined and demonstration projects are reasonable examples as to technology and profitability, the industry will follow. Promptness is essential. Projects now under way must be brought to completion and not waste the funds already expended. In the U.S. with wide variation in climate and environment, multiple projects to demonstrate applicability are often necessary. District heating and cooling feasibility and demonstration programs now under way or being considered are modest in relation to the savings in critical fuels that may be realized.
- Tax eform is needed to allow district heating facilities to be eligible for tax-exempt industrial revenue financing, to allow an increased rate of amortization for district heating and cooling equipment, and to encourage the residential market by allowing an energy credit for district heating retrofit costs.
- Reduce governmental constraints. Some district heating utilities are in a no growth state because of conflicting, unclear, and misunderstood limitations imposed by the federal government. Review and revision by a joint industry/government committee with prompt correction is needed.
- Financial Assistance. U.S. utilities are, at present, having great difficulty in raising funds for capital projects regardless of their need. Some assistance from the federal level, such as that granted aircraft and automobile manufacturers but on a much reduced scale, is a needed incentive.

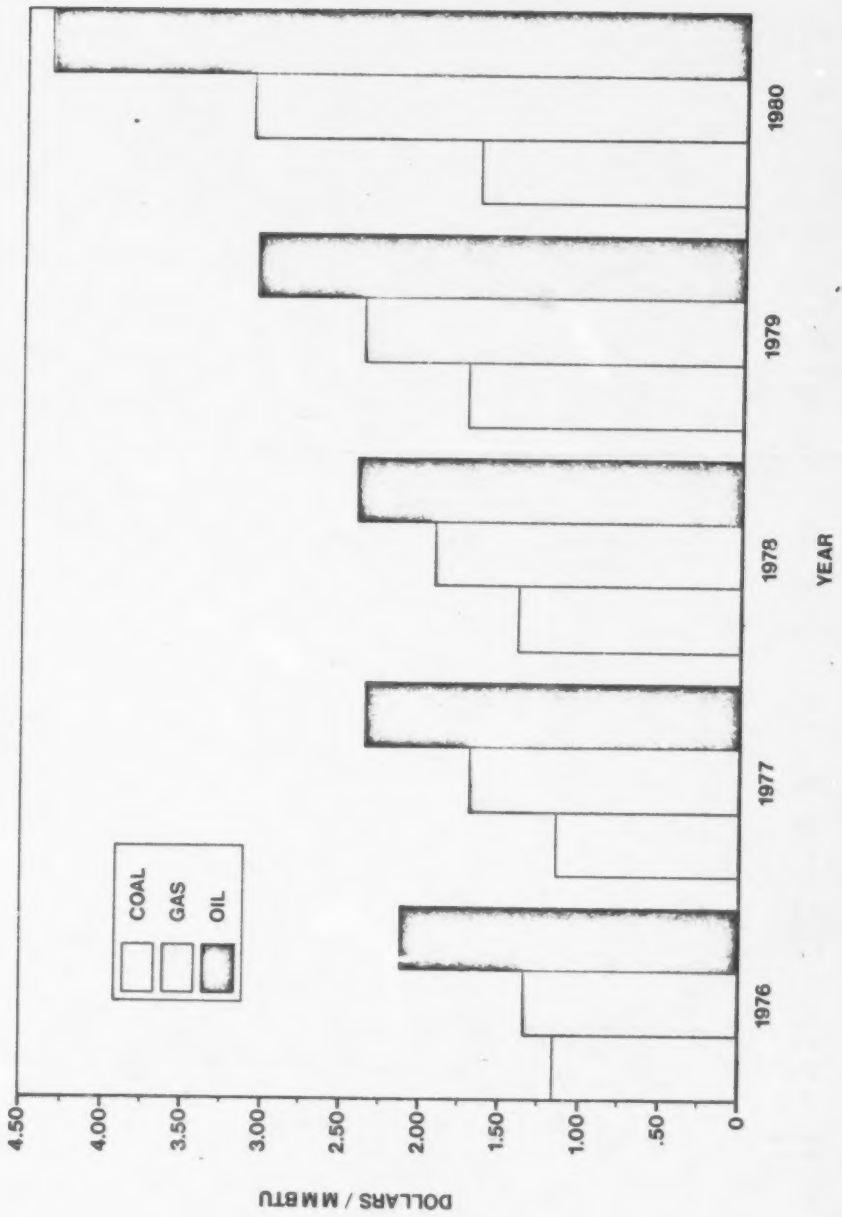
District heating can save the energy dollars now wasted, it can help solve social problems, and it can be done within the private sector. District heating and cooling can mean good business for the utility, the consumer, the local government, and at the same time be in the best interest of our national objectives.



TEN YEAR SUMMARY OF STEAM SENDOUT AND SALES

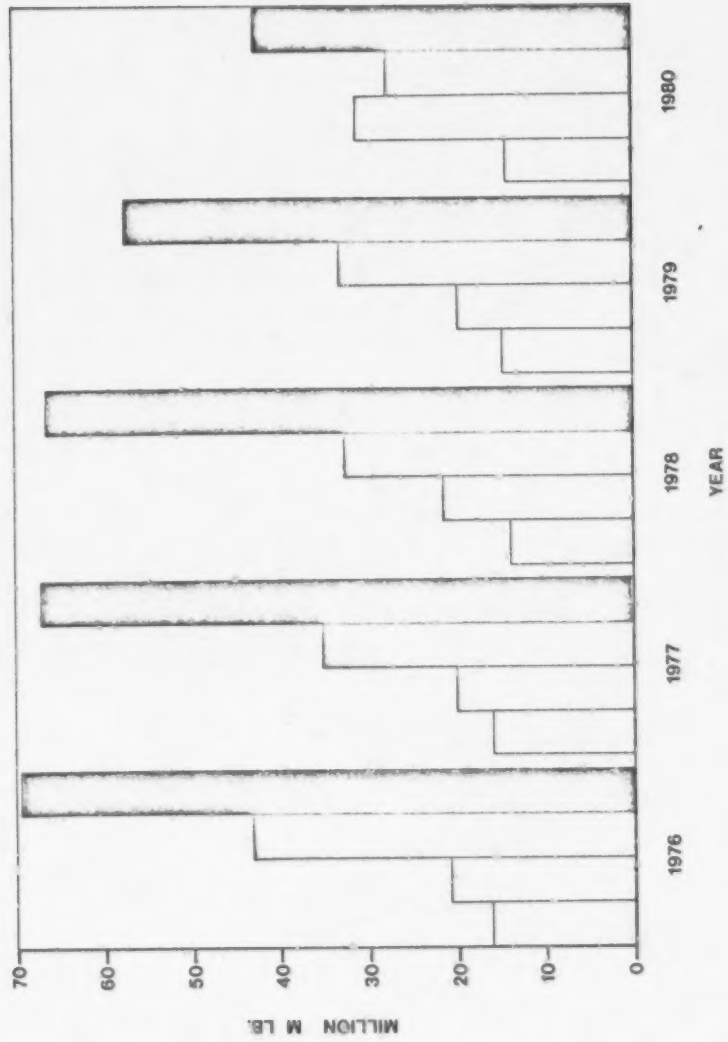


AVERAGE FUEL COST

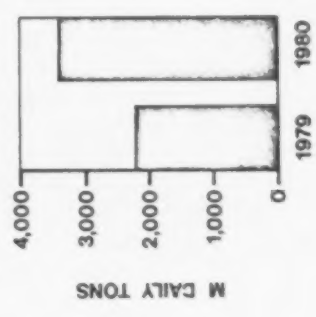


POUNDS OF STEAM PRODUCED BY FUEL TYPE

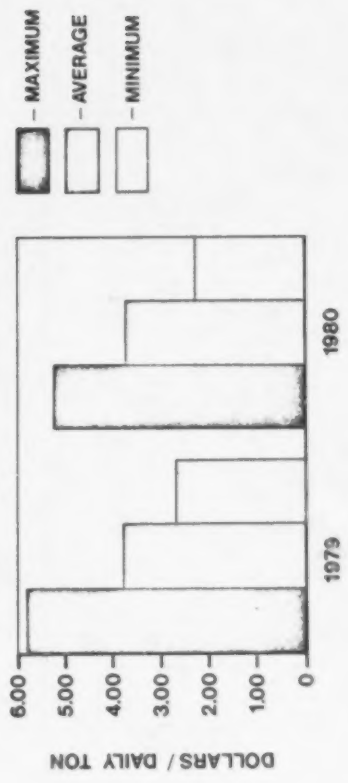
COAL
 GAS
 TURBINE
 OIL



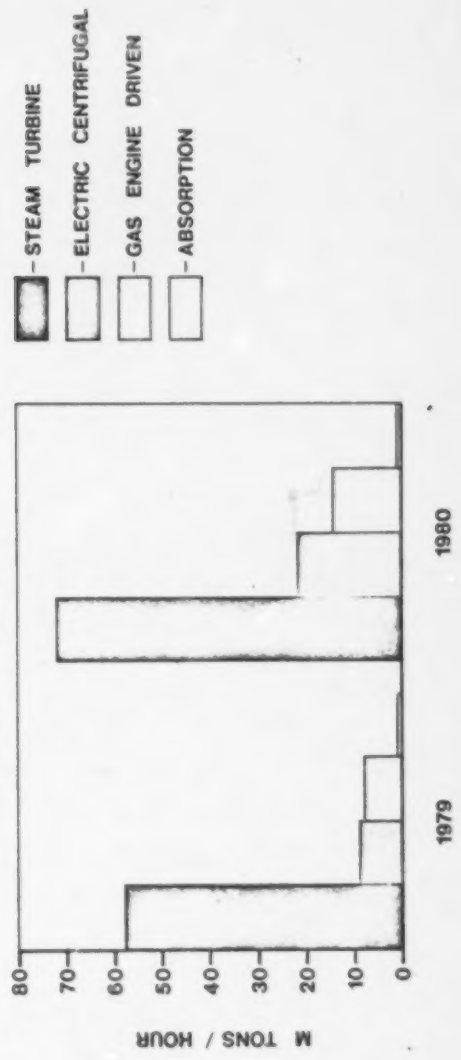
CHILLED WATER SALES



CHILLED WATER REVENUE



INSTALLED CAPACITY



Mr. VOLKMER. Our next witness will be Ms. Mary Procter who is with the Office of Technology Assessment Energy Group.

I would appreciate it if we could, as Mr. Taylor and our previous witness have done, have the testimony within about 15 minutes. We have another panel after this one. Of course, your statement will be made a part of the record and you can either read it or summarize, either way you wish.

STATEMENT OF MARY PROCTER, ENERGY GROUP, OFFICE OF TECHNOLOGY ASSESSMENT

Ms. PROCTER. Thank you very much, Mr. Chairman.

I am a project director of a study at the Office of Technology Assessment called "The Energy Efficiency of Buildings in Cities." That study includes an analysis of district heating.

I have brought with me today Mr. Eric Bazques, who worked on the details of that study—he is to my left—but he is also very knowledgeable about cogeneration, which is also being studied in a separate study called "Dispersed Electric Generation." That study deals with cogeneration of all sizes, including cogeneration for citywide systems. My testimony will deal only with district heating and will treat cogeneration as one cheap source of heat for district heating.

I would like to start by reemphasizing several points that have been made by previous speakers. First of all, district heating is thriving in Europe and is being introduced in many different countries.

Second of all, district heating is not thriving in this country. Of the 50 or so steam systems in this country, most are losing customers. The major city systems are earning very low rates of return, and the Chicago system, for example, went out of business 2 years ago.

A third point is that Europeans claim lots of advantages for hot water over steam, and this leads potential investors in this country to consider hot water seriously.

Now with this as background, I would like to stress some points about district heating from the point of view of an investor in a new system. That investor could be a public investor or a private investor. I can boil this down to eight points that any investor has to keep in mind.

First of all, a citywide district heating system is a major capital project. The full cost of a citywide St. Paul-Minneapolis district heating system is estimated at \$1.2 billion and it would take 20 years to complete. For those of you who are familiar with the Washington, D.C. Metro system, also a major capital project, this is about 12 percent of the cost of that system. It is six times as much as the cost of the second span of the Chesapeake Bay Bridge which was also a major capital project.

The second point is that district heating is capital-intensive. That means that most of its cost comes from the cost of capital, not the cost of fuel and not the cost of labor. Depending on the cost of finance, anywhere from 60 to 85 percent of the cost of district heating can be the cost of capital.

A third point is that more than half of the capital cost of a district heating system is for the piping systems alone, the big

conduits, the big transmission pipes, and the smaller distribution pipes. Of the \$1.2 billion for the St. Paul-Minneapolis system, \$0.8 billion is estimated to go just for the piping system.

Given that the capital cost of the transmission and distribution system is so high, the cost of heat should be preferably free, and if not free, very cheap. This is why cogeneration is in some ways virtually the only source of heat for district heating. You have to be able to share the cost of heat for district heating with something else. That can be shared with electrical generation, or it can be shared with municipal solid waste disposal, or if you are very lucky, and you are sitting on top of a geothermal source of heat, you can use that, which is virtually free.

Now this is a very major point coming up: District heating systems may face serious problems in competing for customers—especially the large customers that allow the transmission and distribution costs of the district heating systems to be minimized—when those customers are using conventional sources of heat, particularly natural gas or heavy fuel oil—that is, No. 6 or residual fuel oil—which is a good deal cheaper than light fuel oil.

District heating systems are so dependent on having large customers hooked up in advance to the system that you really cannot launch a district heating system without having your major customers sign preferably "take-or-pay" long-term, 20-year contracts. That means that they must pay for the heat whether or not they use it.

This helps guard against one danger for district heating systems, which is that customers sign up for a certain amount of heat, then through innovative techniques of management or some capital investment, decide they do not need to use that much heat. They install energy conservation measures and their heating demands might drop by 30 or 40 percent. This could raise the per unit capital cost of a district heating system by as much as 60 percent.

Not every large building can be hooked up to a district heating system. The easiest ones to hook up are those that are under construction and can be persuaded to install a hot water distribution system for heat. The next easiest are those that already exist but already have hot water distribution. The third easiest are those that use steam for distributing heat, and these can be converted at some cost to hot water.

It is very difficult to convert a building to using district heat that uses electric resistance heating, heat pumps, or uses air to circulate heat. Unfortunately a large number of downtown, large buildings, prime customers for district heating, use these types of heating systems. These are so expensive that unless the hookup were provided free, the building owner would never consider doing it.

Another point is that given the high capital costs and current technology, district heating is unlikely to be feasible for U.S. cities in temperate or warm climates. As has been pointed out in Mr. Dunn's comments, the technology for district cooling is not yet advanced enough or cheap enough to compete with the very high efficiency of large electric chillers, which can have efficiencies of four times the cooling output for the fuel input.

A very large system of the type that has been proposed for St. Paul runs a clear danger of cost overruns. There is a recent Rand

Corp. study of major public works projects that calculated on average, for 8 rapid transit projects and 58 major building projects, the cost overrun was 50 percent. For one-of-a-kind projects—and the first few district heating systems with hot water in this country would fall into this category—the cost overrun averaged 100 percent.

Now if you combine the danger of cost overruns with the high capital cost, you get a range of price uncertainty for district heat of 2.5 times. We did the calculation in table 1 of my prepared statement: At the low end, with 6 percent interest financing over a 20-year period and about \$2 for the shared cost of fuel and operations, you could price district heating for \$5.17 per million Btu's. That competes with fairly inefficient use of natural gas and heavy fuel oil.

At the high end, if your costs were at the high end of what you had estimated and you also had to finance the system with 14-percent interest and 20-year bonds, you would not be able to price your heat for under \$13.50 per million Btu's, which at current prices—this is all in 1978 dollars—only competes with electric resistance heating. At that price you could probably only convince a new building that had never put in a heating system not to put in electric resistance heating and to put in district heat. It would be very difficult to attract existing buildings to hook up.

Therefore, the Federal Government and the Congress are faced with a dilemma about the long-term strategy for district heating in this country. Clearly, if it is subsidized with tax-exempt financing, district heating is competitive with existing fuels at current prices. There are, furthermore, many reasons to believe that district heating prices will remain stable and more stable than prices of conventional fuels.

Mr. Harkin mentioned a small town in his district that did not suffer the price increases of other heating customers because they had district heat. There are two reasons why district heat prices are likely to remain stable: One is that it is very easy to use coal for large district heating systems, and coal is not likely to either go as high or go up as fast in price as other sources of fuel. The other reason is, because the major part of the price of district heating is capital cost, debt service remains constant over time and in fact goes down compared to inflation over a 10- or 20-year period.

However, there is some uncertainty in this country about what is going to happen to the prices of conventional fuels. There is no doubt that fuel oil will continue to escalate. Some observers believe that electricity, however, may stabilize in the late eighties because utilities will have brought on their major new powerplants and will not have to raise prices as much once they stop bringing on new powerplants at quite such a rapid rate as they are now.

Other observers believe that even natural gas may stabilize once it has caught up with fuel oil in about 1985 because its major competitor is going to be electricity. If you have very high efficient use of electricity through heat pumps, then natural gas cannot go much higher than the equivalent in efficiency or it will start losing a lot of customers to electric resistance heat. Therefore, it may be that natural gas escalates quite rapidly until the mid- or late eighties but then stabilizes after that.

Therefore, the big gamble about district heating in this country is whether or not, if it is subsidized now, it will actually turn out to be a very competitive source of heat in the nineties. There is a good chance that it will be but there is also some possibility that other sources of fuel and energy, and energy conservation, will also stabilize prices in the nineties.

Thank you for your attention. I would be very pleased to answer any questions.

[The prepared statement of Ms. Procter follows:]

TESTIMONY OF MS. MARY E. PROCTER

Project Director, Office of Technology Assessment

Before the

Subcommittee on Energy Development and Applications

of the U.S. House of Representatives

Committee on Science and Technology

District Heating and Cooling

July 23, 1981

Thank you for the opportunity to testify today on district heating. At the Office of Technology Assessment, we are just completing a study of the Energy Efficiency of Buildings in Cities which includes an analysis of district heating in U.S. cities. I am the Project Director of that study and am pleased to report on our work on district heating in this hearing.

My testimony will deal primarily with district heating and only in passing with cogeneration -- simultaneous production of heat and electricity. The technical characteristics and costs of cogeneration, especially cogeneration for individual or small groups of buildings, are being explored in some detail in another OTA study, Dispersed Electricity Generation, to be published this fall. In this testimony, I will treat cogeneration as one of several possible sources of heat for district heating. Other sources include coal fired boilers, municipal solid waste incinerators, and geothermal.

I would like to begin by reviewing some important points which OTA believes must be stressed in an understanding of district heating and its prospects in this country.

1. District heating has been successfully introduced in Europe and Japan since World War II and continues to be expanded. Most systems use hot water rather than steam.
2. District heating using steam is now predominant in this country but is shrinking in numbers of customers and sales. District heating systems in this country are old -- many more than fifty years old -- inefficient, and charge fairly high prices for their heat. This is partly a result of reliance on direct burning of expensive fuel-oil and partly a result of the high maintenance costs at this stage in the life of a system which is not well-insulated and uses a highly corrosive material like steam. The high prices charged for heat cannot compete in many cities with direct use of natural gas, #6 (heavy) fuel oil or even #2 (light) fuel oil, and so the systems are losing customers. The Chicago system closed two years ago; the Detroit system has a negative return on its assets. Offsetting the reductions in these older systems, there has been some successful new investment in recent years in U.S. steam systems. The City of Nashville Municipal Utility, for example, refurbished and expanded an existing steam distribution network in its downtown area, and built a waterwall solid waste incinerator to provide steam. The system has successfully operated since the summer of 1974.
3. Europeans claim many advantages for their hot water systems over the older steam technology traditionally used in this country. Hot water allows less expensive steel or plastic pipes to be used because it is much less corrosive. Maintenance is easier because

there is no steam condensation to worry about. Hot water systems allow a cogenerator to operate with maximum electrical output -- an important element in cost effectiveness. Of course, there are some disadvantages. Hot water can only be used to run certain kinds of air conditioners and cannot provide high-pressure process steam. More important for the prospects of hot water systems in this country, it costs a lot to retrofit a building that was originally equipped to use steam for heat (and often steam-fired air conditioning) to be able to use hot water. Because many of our largest cities have had or still have steam district heating systems, many of the downtown buildings in these cities are equipped to use steam.

I would now like to describe the prospects for new district heating systems in this country. Much of what I will say is based on our analysis using several feasibility studies of a small number of new systems. The latter include:

1. Feasibility studies have been completed for a \$77 million downtown district heating system for St. Paul. The system is now proceeding with obtaining financing and setting up the non-profit corporation which will run the district heating system.
2. A much smaller system in Trenton, New Jersey, is also well along in development. Feasibility studies are also complete. Financing is nearly arranged and most regulatory problems have been solved. The system will be owned and partly financed by a private partnership but will also have about 75% subsidized financing from tax-exempt industrial revenue bonds and an Urban Development Action Grant loan.

3. Argonne National Laboratory completed preliminary studies of the costs and likely market for district heating systems in four major Eastern cities -- Boston, Philadelphia, Baltimore, and Washington, D. C. They performed a similar study for five Midwestern cities -- Milwaukee, Chicago, Detroit, Cleveland, and St. Louis.

For either a private or public investor contemplating a new district heating system, or a refurbished and expanded old one, the following are the most important findings of our assessment of the prospects for new systems.

1. A city-wide district heating system is a major capital project.

Although the downtown district heating system for St. Paul is estimated to cost only \$11 million, a full city-wide system would cost \$1.2 billion. The cost is comparable to major public works projects such as mass transit systems and major private projects such as nuclear power plants. To give some perspective, the full St. Paul/Minneapolis would cost more than a tenth of the full Washington, D. C. Metro system on the one hand, but about six times as much as the second span of the Chesapeake Bay Bridge were it to be constructed today. Systems can also be small, however. The proposed Trenton system, to serve 19 customers, the largest of which is a State of New Jersey office complex and a large hospital complex, is expected to cost just under \$20 million. The Nashville steam system is another example of a recent small system. Some European cities developed their district heating systems in pre-planned steps so that the very high cost of the full system could be paid for by revenues from smaller incremental systems.

2. District heating is very capital-intensive. Capital, not fuel or labor, is the major element of the cost of district heat. Depending on the cost of finance (discussed later in the testimony) the cost of capital can be anywhere from 60% to 85% of the cost of district heat.

3. More than half of the capital cost of a district heating system is for the hot water or steam transmission and distribution system. Out of the \$1.8 billion estimated capital cost for the full St. Paul/Minneapolis system, over \$1.2 billion will go just for the transmission and distribution network. Providing the large transmission pipes or conduits, can cost up to \$2,000 per foot; providing the distribution network of smaller pipes costs several hundred dollars per foot. The transmission and distribution costs of a district heating system are least per unit of heat produced, and sold, for systems with a few large customers each demanding heat at a rate equivalent to the demand of a 100,000 square foot office building in a fairly cold climate. Distribution costs are further minimized if these customers are close enough together to be at least equivalent to multi-story downtown areas of U.S. cities and preferably equivalent to highrise downtown areas. The transmission and distribution costs per unit of heat will be thirty percent higher in the second phase of the St. Paul/Minneapolis system than in the first phase. This is because the second phase of the system will reach out into lower density residential areas.

4. Because the capital cost of the transmission and distribution systems for a city-wide district heating system is so high, the cost of the heat itself must be kept as low as possible through using coal and/or cogeneration or other very inexpensive heat source. The St. Paul/Minneapolis district heating system will use waste heat from several coal-fired electric generating plants. The proposed systems in such cities as Detroit, Washington, and Chicago would also use waste heat from coal-fired cogeneration of electricity. Coal costs much less than fuel oil or natural gas per million Btu. Cogeneration permits the cost of fuel and operation of the powerplant to produce both heat and electricity to be charged both to electricity and district heat. In this way the cost of the heat itself can be kept to a range of \$1.50 to \$3.00 per million Btu before the capital cost of the system is added on.

Small systems like the Trenton system, which can minimize their distribution costs by catering to a few large customers, may find it more economical to use cogenerating equipment that uses oil or gas. For small systems, such equipment is less expensive per unit of heat produced than is coal-fired equipment with full protection against air pollution. The high fuel cost of oil or gas can be tolerated in such systems because the capital cost of the distribution system is not so great.

5. District heating systems may face serious problems in competing for customers, especially large customers, using conventional sources of heat. Shortfalls in anticipated demand for heat can add to the capital cost per unit of heat sold. Since there are no laws in

this country requiring buildings to hookup to district heat, district heating systems must offer heat at or below the cost of heat from conventional fuels in order to persuade owners of new or existing buildings to hookup. A reliable group of large customers who have agreed to buy heat from the district heating system is so essential that it is usually necessary to secure firm long-term (20 year) contracts from such customers before the system is implemented. Take-or-pay contracts which require the customer to pay for a certain amount of heat whether it is used or not, are most protective of the district heating system.

The best bet for hot water district heating customers are buildings under construction whose owners can be persuaded to install heating systems with hot water distribution in anticipation of a completed district heating system. Such new buildings could be new private office buildings, new government buildings or new large multi-family buildings which provide 50-70% (depending on the city) of all new housing in central cities in the Northeast and Midwest.

The easiest existing buildings to hookup to a district heating system are those which already use hot water to distribute heat through such means as hot water radiators or hot water baseboards. Even for these buildings it may cost the same as a whole year's fuel bill to adapt the building to district heat. The smaller the building the more expensive the retrofit in relation to the heat supplied. Buildings equipped with steam distribution systems, characteristic of many buildings in the downtowns of U.S. cities, can also be adapted to district hot water but at considerably

greater cost, equal to several years' fuel bills. Both buildings with steam distribution systems and buildings with hot water systems will use light fuel oil, heavy fuel oil or natural gas. At current prices, it is easier for district heating systems to set prices below light fuel oil than it is to set prices below heavy fuel oil or natural gas which cost 30-40% less than light fuel oil.

Existing buildings with fuel-fired air systems to distribute heat or electric resistance heat are very expensive to adapt to district hot water and are very unlikely to become district heating customers unless they are undergoing a major renovation that justifies a whole new heating system.

Even once they have hooked up their customers, district heating systems must have take-or-pay contracts or face the possibility that customers will purchase less heat than the distribution system was planned to deliver. For example, OTA estimated that costs per unit of delivered heat for a system for the District of Columbia would increase by 60% if customers purchased 40% less heat than anticipated. Such reductions in heat requirements are possible as techniques of improved energy efficiency in large buildings become more widely adopted.

6. With current technology and at current financing cost, district heating is unlikely to be feasible for U.S. cities in warm climates. Capital costs per unit of heat delivered are much higher for the shorter heating seasons and lower load factors (ratio of average demand for heat to peak demand for heat) characteristic of cities such as Dallas. The addition of district cooling is not

likely to make such systems economically feasible since with present technology, district cooling is usually not competitive with the high efficiency of the large electric chillers used in the buildings that are the prime customers of district systems.

7. For large district heating systems, cost overruns are likely at first and must be allowed for in planning. A RAND study of cost overruns in major public and private projects calculated that the average cost overrun in eight rapid transit projects and 58 major building projects was over 50%. For one-of-a-kind projects, cost overruns were higher -- 110%. The first few district heating systems in this country are likely to resemble one-of-a-kind projects until design and construction companies have more experience. To allow for such uncertainty, the Argonne estimates of costs for district heating systems in Detroit, Milwaukee and other cities includes a low and a high cost estimate. The low cost estimate for Milwaukee, for example is \$1.2 billion -- the high cost estimate for the same system is \$2.9 billion. For smaller systems like Trenton's it may be possible to avoid cost overruns by careful feasibility analysis and realistic incorporation of the experience of previous projects, but this appears imprudent optimism for city-wide projects.

8. Since the cost of district heating is almost entirely capital cost, the cost of financing has the major influence on the price of heat. The price per unit of heat of a project financed with 20 year bonds at 14% interest per year will be almost 50% higher than the per unit costs of a system financed with 20 year bonds paying 6%

interest. The latter is possible for tax-exempt municipal financing.

To illustrate the enormous impact of the last two points, it is useful to look at the capital cost and likely price for a district heating system in Milwaukee using two different assumptions about financing cost and Argonne Lab's estimates of low and high construction cost.

TABLE I

Per Unit Cost of a District
Heating System for Milwaukee

(\$ per million Btu of district heat delivered)

	<u>Capital Cost Only</u>	<u>Total Cost*</u>
<u>Case 1:</u> 20 year bonds at 6% interest		
Low Cost Estimate	\$ 3.17	\$ 5.17
<u>Case 2:</u> 20 year bonds at 6% interest		
High Cost Estimate	\$ 6.56	\$ 8.56
<u>Case 3:</u> 20 year bonds at 14% interest		
Low Cost Estimate	\$ 3.45	\$ 7.45
<u>Case 4:</u> 20 year bonds at 14% interest		
High Cost Estimate	\$11.51	\$13.51

* Assumes \$2.00 per million Btus of operating cost for district heating's share of fuel and maintenance from a coal-fired cogenerating plant.

Under the above four options, the minimum cost of heat to the consumer would range from a low of \$5.17 per million Btu with financing at 6% interest and low construction cost to a high of \$13.51 -- two and a half times as much -- with financing at 14% and high construction cost. The former cost would be competitive even with natural gas or heavy heating oil at current prices. The latter would not now be competitive with any other sources of heat except very high cost electricity (about 10¢ per Kwh).

This situation leads to a central conclusion about the feasibility of district heating. At today's high cost of private finance, early examples of district heating systems, which face a clear risk of cost overruns, likely will have to be subsidized by low cost financing at least in the early years. If they are not so subsidized they probably cannot set their prices for heat low enough to attract the volume of customers needed to be viable.

District Heat as a Long-Term Strategy for the United States.

District heat is not likely to be able to compete in the 1980's with conventional sources of heat without subsidized financing. The next question is: Will it become a competitive source of heat in the 1990's and for the several decades thereafter? Prices for district heat are likely to escalate very slowly over time for two reasons.

- a. District heat is well adapted to using coal, which is likely to escalate slower than oil over 30 years, and municipal solid waste, which is also not likely to escalate in price.
- b. Once a district heating system is fully constructed, debt service on the system will be the same each year in current dollars and will therefore decrease in cost in real terms net of inflation.

The likely stability of district heating prices in comparison to both general inflation and fuel escalation greater than inflation must be compared with the likelihood of both continued inflation and continued escalation in fuel cost. I am not in a position to comment on prospects for general inflation but I can report on the current projections of the future behavior in fuel and electricity prices.

There is agreement that prices of light and heavy fuel oil are likely to increase significantly faster than inflation. Several forecasts, however, predict stable prices of electricity beginning in the late 1980's as the current group of plants under construction are completed and brought on line. Since district heat is likely to compete with electric resistance heat and heat pumps for new building customers in some cities, the forecast stability of electric prices is significant.

There is similar uncertainty about the future price path of natural gas. The price of natural gas is expected to increase rapidly in the mid-1980's as it is decontrolled. There is disagreement, however, about how high natural gas prices will rise before stabilizing. Some observers argue that the price of natural gas will stay even with the price of fuel oil. Others argue that natural gas will eventually compete for the space-heating market primarily with electricity. Under this argument, if electricity prices stabilize, natural gas prices will too, at a level well below the price of fuel oil.

If natural gas and electricity escalate more rapidly than predicted, or if district heating can compete primarily against fuel oil that is rapidly escalating in price, and if there continues to be general inflation which makes fixed annual debt service less burdensome over time, then district heating will be competitive in the 1990's even if financed at current

interest rates. If inflation slows and fuel prices stabilize, district heating may never be feasible at current high financing costs.

If on the other hand private interest rates come down, private market investment in district heating may become feasible again regardless of expected fuel escalation predictions.

Planning and construction of district heating systems which may be competitive in the 1990's must start soon. If there is good reason to believe in the long-term feasibility of such systems, one possible Federal government option is to subsidize them in the 1980's while they are unable to compete, unsubsidized, with conventional sources of fuel.

Thank you for your attention. I would be pleased to answer any questions.

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Mr. VOLKMER. Thank you very much, Ms. Procter. We will now hear from Mr. Alan Hills, the second vice president of Bache, Halsey, Stuart, Shields, Inc., from New York.

[The biographical sketch of Mr. Hills follows:]

Bache Halsey Stuart Shields Incorporated

ALAN L. HILLS - Second Vice President. Mr. Hills joined Bache in 1981. Prior to that time he was an Officer in the Public Finance Group of E.F. Hutton & Company. While at Hutton, he participated in financings for pollution control and industrial development facilities, housing, education and various types of tax-exempt energy projects. Specifically, Mr. Hills specialized in the area of joint-action and municipal utility system financings, having experience with the Power Authority of the State of New York, Piedmont Municipal Power Agency (South Carolina), Omaha Public Power District, North Iowa Municipal Electric Cooperative Association, Intermountain Power Agency (Utah) Sebring Utilities Commission (Florida) and most recently with New Martinsville, West Virginia in connection with its proposed 70 MW Hydroelectric Power Project. In addition, Mr. Hills was involved in several resource recovery financings and a 165 MW cogeneration district heating project for the City of Saint Paul, Minnesota. He is presently working with the Trenton (N.J.) District Energy Company on a 60 MW cogeneration district heating project.

Prior to joining Hutton, he was an Officer in the Municipal Bond Department of The Bank of New York. Mr Hills received an M.B.A. in Finance from the Wharton School of Finance and Commerce at the University of Pennsylvania, a B.A. in Accounting from the University of South Florida and is a C.P.A. in the State of Florida.

In addition to acting as the Senior Managing Underwriter for the financing of the Saint Paul and Trenton Projects, Mr. Hills' experience in district heating includes participation in the U.S. Conference of Mayors Critical Issues Panel on the Financing of District Heating and as a contributing advisor to the forthcoming Interagency District Heating Task Force Final Report on National Policy Recommendations for Federal Programs and Incentives for District Heating. Mr. Hills is currently working with several urban communities on the development stages of proposed district heating systems.

STATEMENT OF ALAN HILLS, SECOND VICE PRESIDENT, BACHE, HALSEY, STUART, SHIELDS, INC., NEW YORK CITY

Mr. HILLS. Thank you, Mr. Chairman. On behalf of my firm, Bache, Halsey, Stuart, Shields, Inc., and myself, I thank you for the opportunity to testify here today.

What I would like to do is briefly summarize my prepared statement and discuss some of the specific barriers to the financing of district heating systems, which in the final analysis are determinants of whether systems will or will not be constructed. This discussion is based on my experience as the managing underwriter for the two major district heating projects in this country that will be the first to be financed with any amount of private investment capital. These are, namely, the St. Paul district heating project, which has been discussed here at some length, and the Trenton integrated community energy system, which with the support of Mayor Holland and the city of Trenton should be, within the next 2 months, the first privately financed district heating system in this country.

Briefly, to give you the background of how we are going to finance Trenton, the project is going to be financed with a combination of Federal support and private moneys, specifically, \$3.88 million of UDAG loan moneys provided by the city of Trenton through the \$4 million UDAG grant they have received from the

U.S. Department of Housing and Urban Development. There is also a \$450,000 Department of Energy grant to the project. There will be \$10 million of tax-exempt revenue bonds which will be issued, again, within the next 2 months. Finally, there will be approximately \$10 million of financing provided through what is called a leveraged tax-lease financing of certain project equipment.

Briefly, the Trenton project should come in at an overall cost of the financing, combining all of the private funds as well as the interest rate on the UDAG moneys, of something in the order of 11 to 13 percent. Specifically, the cost will depend on market interest rates when we actually raise the moneys. However, the Trenton project would not be at all feasible at this point in time, and neither would St. Paul, if there was not the availability of some amount of tax-exempt revenue bond financing.

More generally—as a result of the OPEC price increases, and the resulting impact on energy prices generally in this country over the last 5 to 10 years, and also the expectations of future increases I would think most people presently have—the economic viability of both new and renovated existing cogeneration district heating systems has been greatly enhanced in the last few years. In addition, the technology—as several of the speakers here have already mentioned—has a very long and successful history of commercial-scale operation, specifically and primarily in the European countries over the last 20 to 25 years.

However, in this country, while these energy cost trends are taking place, you are gradually seeing a number of presently operating systems going out of service or facing capital rehabilitation costs, primarily because many are fairly inefficient steam systems, that will probably result in many of them going out of business over the next 5 years.

In addition—and I think this is the reason that these hearings are being held and that Representative Oberstar's bills have been submitted—the identification and development of new, hot-water cogenerated district heating systems, by both the public and private sector, is not proceeding at the pace that would be warranted by the reliability, the efficiency, and the cost of service that a district heating system can provide.

Some of the most important impediments to this increased use of district heating are four specific financing problems or, as I have termed them, financing barriers that I would like to briefly discuss with you. The first of these impediments to the expansion of district heating is simply the lack of a sufficient amount of the risk capital that is required in the initial identification of potential systems as well as, once you have located a system that seems to have good potential, actually going through with the assessment and engineering process which is required before private financing can be obtained for a system.

For individuals and private developers—though there are private developers in many situations such as the Trenton project that support the development of district heating on economic merits—there is not yet today, given energy prices and capital financing costs, sufficient expected profitability from investments in district heating as opposed, for example, to other private type investments, many of which are also in the energy area.

From a local government standpoint there is some question as to whether significant amounts of local government money should be spent in the sort of risk analysis that is required to develop district heating systems. Many times community support for the early stages of such a development is very difficult to obtain.

The second barrier—and one that Ms. Procter has already mentioned—is the fact that district heating systems replace operating costs, fuel costs to a large extent, with a capital-intensive centralized heating source. This capital intensity results in very large initial debt service costs for any private financing that could be obtained for a district heating system.

This is a major barrier for many systems because of early-year operating deficits that result, because these systems cannot price their service at rates that are above the current best alternative cost of energy, whether it is natural gas, which is predominant in the Midwest, or a mixture of natural gas and electricity, which is more prevalent, say, in the Pacific Northwest.

Therefore, one of the problems to be addressed is how you develop a system today which over the long run, 10, 15, 20 years, will develop significant energy cost savings, when you have an early-year problem of bringing the system on line and being able to be self-supporting for its financing.

The third major problem which, again, has been touched upon here, is assuring that you have adequate customer demand, customer hook-ups, for the district heating system. This, from a private financing standpoint must be in place under long-term contractual arrangements prior to raising any amount of funding. This particular problem was the prime financing barrier, as concluded by a U.S. Conference of Mayors' critical issues panel on financing of district heating, in which I was a panelist earlier this year.

In other words, the lack of sufficient customer hookups on a guaranteed basis is the major impediment of all four previously mentioned, that makes the feasibility of some systems questionable. I know in St. Paul, which is relying upon a number of users both large and small, the probability of getting 100 or more customers signed up before the financing was initially a very large concern of theirs. The Trenton project, which in the core development is only going to have a small group of initial customers, did not have quite that problem but, sufficient customer hookups is more generally a major problem that other district heating systems being considered, such as Bellingham, Wash., will have in arranging private financing.

Finally, the last financing barrier I want to discuss today is the impact of the knowledge that private investors in the debt markets—particularly the municipal bond, tax-exempt debt market which has historically been a very conservative group of investors—have of district heating. That knowledge, if they have any at all, is of the antiquated and in many cases very unprofitable existing steam systems in the United States.

These investors have little knowledge of European district heating experience. They frankly have a bias that though something worked in Europe, that does not necessarily mean at all that it will work in this country. They point, for example, at the early applica-

tions of solid waste resource recovery technology in this country as a prime example of that concern.

Also, their very lack of knowledge provides the initial projects—Trenton, St. Paul, Bellingham, et cetera—with much more stringent hurdles to cross in terms of structuring their financings, structuring the security for raising private moneys, than future systems—many, perhaps, of those that have just received the DOE and HUD grants to analyze district heating—will have to deal with after initial projects are successfully developed.

We turn now to the options that you all have to consider to address these various financing barriers. In addressing these concerns one prime criterion should be the efficiency or the leverage that any particular Federal support would result in, in terms of the commitment of private or public nonfederal financing for any proposed district heating project.

To address a lack of sufficient risk capital from the private sector, the alternatives might include a program of governmental grants or loans, perhaps loans on a forgivable basis similar to those that DOE utilized in the small hydro program. In other words, funds would be provided to assess development potentials of district heating projects. To the extent that a project—after initial review of its potential, before private financing—was developed, this feasibility study loan money could be repaid over the operating life of the project. To the extent that a project for whatever reason was not developed, repayment by local governments of some portion or all of this loan could be forgiven, in effect turned from a loan into a grant.

Additional Federal tax incentives for the initial development/analysis phase could be provided. Representative Oberstar's bills, and I think both bills are very good bills, deals with tax incentives at the customer hookup stage, which is very important. However, you have to get to the hookup point with a system before anyone can utilize the tax incentives from the Oberstar bill.

A third possible aid to the initial investigation of district heating could be some sort of Federal or State support through programs to give partial guarantees of repayment for private financing of district heating assessment activities. Not only would this lower the cost of raising those funds but it would also encourage—because of the lower cost—more private interest in analyzing district heating.

To address the operational feasibility concern—once a project has been assessed as feasible, getting it on-line and having it support itself from day one, which private investors will require that systems do—both the bills from Representative Oberstar and also H.R. 848, which is Representative Les AuCoin's bill to provide energy development and conservation action grants, would be very effective.

Both the grant moneys and the low-interest Federal loan support that those two bills would provide make the debt service requirements, and therefore the cost of the energy that must be sold by any newly developed project, much lower than it otherwise would be. This will encourage conversion of existing users' buildings to these systems, and also will act in many cases as a spur to private investment since the risk to the private investor would be reduced

to the extent that a portion of project funding is provided at very attractive interest rates by the Federal Government.

One other alternative Federal incentive for the operational development of district heating might be some sort of risk-sharing program. This is a concept of having the private or the non-Federal public parties having some financial commitment to the development of a system. Some form of support could be provided for the early-year operating costs of a system, which would be repaid over the later years of a project when, if energy prices continue to increase at any gradual rate, systems will become much more profitable, making funds available to repay initial operating subsidies.

In marketing district heating, developing the thermal load which is the key to feasibility of these projects, the funding could be similar to that provided by H.R. 3204: Federal tax incentives to both private individuals as well as commercial and industrial buildings on expenditures for conversion to district heating. I think that is probably, of the provisions of the bills presented, the most effective in addressing the major problem from the standpoint of financing district heating, with a low budgetary cost on the Federal side as possible.

Let me discuss briefly how you might evaluate and compare the policy options in the bills that are before you in the House at this point. You should evaluate them, I think, not only on how effective they are, how many systems they bring on, but how efficient they are in leveraging private money.

In the St. Paul project, approximately \$7.7 million of Federal funds from UDAG are going to be leveraged to more than \$50 million of private-source funding. In the Trenton situation, approximately \$4 million of funds from DOE and HUD results in a leveraging of five times that, to \$20 million approximately of private funding. That is a very high leverage ratio when compared with other types of programs being supported by the Federal Government, and I think that is one key criterion for viewing whether these bills are appropriate in this time of budgetary restraint.

Finally, two other points: Federal tax incentives, tax credits, are generally more effective from the private standpoint. Private developers are more likely to act if they can control the Federal support by doing something to qualify for tax credits as opposed, many times, to having to rely on annual appropriations of funding and Federal agency approvals. Conversely, Federal loans or grants are usually more effective in spurring the incentives for non-federal public government development efforts.

One last point: To help both the public and private sector develop district heating, Representative Oberstar commented that his hearings in St. Paul had raised the point that perhaps some additional ability to sell lower-cost tax-exempt financing for district heating might be appropriate, something along the lines of the exempt facilities provisions of section 103(b) of the IRS code that allow things such as pollution control equipment to be financed. The use of lower-cost funding from tax-exempt financing under a similar type of exempt facilities exclusion would allow both sectors, public and private, to develop district heating on a very cost effective basis.

Also, by making it an exempt type of financing it would allow a system to bring on all possible customers, be they public or private. Presently tax-exempt financing in many cases limits to 25 percent the amount of private buildings you can bring onto a system and still be able to sell tax-exempt financing.

Again, I thank you for the opportunity to discuss these financing questions with you and I would look forward to addressing any questions you might have. Thank you.

[The prepared statement of Mr. Hills follows:]

Bache Halsey Stuart Shields Incorporated

BARRIERS TO THE FINANCING OF
DISTRICT HEATING SYSTEMS

By
Alan L. Hills, Second Vice President
Bache Halsey Stuart Shields Incorporated

Statement Prepared for Hearings by the
U.S. House of Representatives Subcommittee
on Energy Development and Applications

July 23, 1981

INTRODUCTIONS

As a result of dramatic past and expected future increases in the cost of alternative energy sources, the economic viability of new and renovated existing cogeneration district heating and cooling systems has been greatly enhanced. Additionally, the technology of highly efficient hot water district heating has a long and successful history of commercial scale application in Europe. However, in spite of these significant technical and economic benefits of district heating, the last ten years has seen the gradual abandonment of operating systems in the United States and many of the remaining systems face major capital rehabilitation costs, which threaten their continued operation.

In addition, the identification and development of new district heating systems by the public and private sectors in many communities has not proceeded at a pace or to the extent warranted by the reliability, efficiency and cost of district heating. One of the most important impediments to the increased use of district heating and cooling has been various financial barriers which limit the identification of potential

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district heating opportunities and can jeopardize the feasibility of proposed systems. This memorandum discusses several of these major financing barriers and recommends specific policy actions by the Federal government which can help to eliminate these financing barriers.

MAJOR FINANCING BARRIERS

One of the most significant impediments to expansion of the market penetration of district heating is the lack of sufficient risk capital required in the initial identification of communities with district heating potential and following through with a detailed assessment of the actual feasibility of proposed district heating systems. For individuals and private firms, the developmental risks and relative payback potential of district heating, when compared to more traditional energy technologies, will limit the search for district heating opportunities.

For local governments, their ability or willingness to assume the total financial risks of evaluating the potential for district heating is even more limited than that of the private sector, this is inspite of the fact that local governments have significant advantages in the development of viable systems through their use of lower cost tax-exempt bonding and the non-profit nature of their operation of district heating systems.

A second financial barrier to the development of district heating is the fact that highly capital intensive district heating systems that would provide significant long run energy savings often have large initial operating deficits that preclude raising private financing at a reasonable cost. These operating deficits normally result from the inability of district heating systems to charge their thermal customers more than the cost of their best alternative energy sources. Due to the capital-intensive nature of new system construction, the debt coverage requirements of private financing and the expectation of escalation in the future costs of alternative energy sources, the economic viability of a district heating system and its ability to generate sufficient net revenues to repay debt financing should increase significantly over the later years of a project, which is not initially feasible.

Another major barrier to the financing of district heating is the difficulty of assuring adequate customer demand to support the development and financing of a proposed system. The most difficult problem in marketing the benefits of district heating or cooling services to potential long-term customers is the impact upon their effective cost of service that results from the substantial initial costs of hooking-up individual buildings. In order to raise private revenue bond financing for construction of district heating systems, a sufficient

number of customers must be signed to long-term contracts prior to the issuance of the revenue bonds. These contracts will provide for a level of customer thermal demand and net operating revenues that are adequate to meet debt service payments on the bonds. These contracts will also provide for a schedule of customer hook-ups to the district heating system that will assure timely receipt of anticipated revenues that will be needed for debt service payments.

A final barrier to the private financing of district heating is the present limited investor knowledge of district heating as an alternative energy concept, the absence of a privately funded and successfully completed modern hot water system and the negative perception of many of the existing, antiquated steam systems in the U.S. After several initial hot water systems are successfully developed and financed (such as the proposed Trenton, New Jersey, Saint Paul, Minnesota and Bellingham, Washington projects), marketplace acceptance and financial support for future district heating projects will become significantly easier to obtain.

FEDERAL POLICY OPTIONS FOR PRIVATE FINANCING BARRIERS

In discussing possible policy actions by the Federal government to help expedite the private sector development of district heating systems, selection of those actions to be undertaken should be based upon the degree of private sector involvement that will result from undertaking various policy actions.

To address the lack of sufficient risk capital to identify and analyze the feasibility of potential district heating opportunities, the policy options include:

1. Direct governmental grants or loans on a forgivable, non-reimbursable basis for potential projects found to be unfeasible. Loans for projects found to be feasible would be repayed from the long-term financing of the project. These "forgivable" loans should be made on a "risk-sharing" basis with the local government or private developer who is investigating a potential project, by requiring a matching of federal and non-federal dollars invested in feasibility studies. (Similar to the provisions of H.R. 3205)
2. Additional new federal income tax incentives (more rapid depreciation allowances, investment tax credits or deductions from taxable income for unrecovered investments in the development of district heating systems) in order to encourage greater private risk or venture capital investment in the identification of district heating opportunities.

The impact of increasing the federal income tax incentives is two-fold: first, the anticipated return on investment of private capital in feasible systems is increased, thereby promoting greater interest by the private sector; second, the loss from private investments in screening potential

projects is reduced through the deductability of unrecovered expenditures.

3. Federal guarantees for private sector loans or direct investments made to finance initial developmental costs for potential district heating projects. Such loans would be repayed from funds raised to construct projects actually developed. Loans for potential projects not developed could be repayed from available pledged resources of the private sector or local government sponsor of the project and borrowers of the loans.

This alternative minimizes the up-front budgetary impact to the Federal government of financing developmental costs while promoting private sector financial involvement in district heating.

To improve the operational feasibility of new, capital-intensive district heating systems, especially in the early years start-up phase, several federal policy actions could be considered that reduce the private financial leverage and resulting debt service requirements of new systems:

1. Provide increased equity for specifically identified "commercial demonstration" projects through direct Federal grants for system construction. (Similar to the provisions of H.R. 848)

2. The security (credit rating) for private financings of district heating can be improved through Federal loan guarantees, with a resulting reduction in the interest costs of financing, and debt service payments to be met out of the revenues of district heating systems. (Similar to the provisions of H.R. 3205)
3. Provide subordinated direct Federal loans for construction costs with interest rates and repayment schedules geared to the projected available net cash flows from the project, after payment of operating costs. (Similar to the provisions of H.R. 3205)
4. Establish a "risk-sharing" program under which the Federal government will make-up early year deficiencies in actual operating revenues of district heating systems, to a maximum limit of exposure, with repayment of any make-up payments from district heating system revenues over future years.
5. Lower the capital-intensive costs of financing the development of district heating systems (which can represent more than 50% of annual operating costs) by providing an exemption under Section 103 of the I.R.S. Code for tax-exempt "district heating" industrial development revenue bonds.

In order to promote the marketing of district heating services to potential users by minimizing the initial costs of hooking-up individual customers' buildings, available policy options would include:

1. Providing direct governmental grants for a portion of the construction costs, or direct subordinated low-interest loans with repayment terms specifically tailored to make the effective cost of thermal energy from a proposed district heating system competitive with alternative energy sources, including the impact of expenditures to convert individual customer buildings.
2. Provide increased Federal tax incentives (such as accelerated depreciation or a special district heating investment tax credit) for qualifying expenditures to convert, retrofit or rehabilitate individual buildings for hook-up to district heating systems. (Similar to the provisions of H.R. 3204)
3. Lower the interest cost of private financing of building conversions through a loan guarantee program, with a resulting improvement in the security for and credit rating of private borrowings.

Any required payments under such a loan guarantee program during the early years hook-up phase of the district heating projects would be repayable

from subsequent system net revenues from operations during later years.

CRITERIA FOR EVALUATION OF POLICY OPTIONS

As discussed above, the Federal government has a finite set of policy options to choose from in the promotion of financings by the private and non-Federal government sectors of new or significantly expanded existing district heating systems. Although several different combinations of these individual policy actions will encourage the expansion of district heating, the selection of actual policies to be implemented can be based in part upon several criteria:

1. Policies (either individually or as alternative sets of policies) should be evaluated in terms of both their effectiveness in successfully removing specific financing barriers, as well as in terms of their efficiency in promoting non-Federal investments in district heating system development.

The efficiency of policy options is often referred to as the "cost/benefit ratio" or "leverage ratio", and is based upon the dollar amount of private and/or local government investment in a project that results from a dollar of Federal financial support or exposure.

2. Generally, Federal tax incentives are most effective in promoting investments in the development of district heating systems by private sector utilities, companies, individual developers and entrepreneurs.

3. Federal grants, loans or guarantees are most effective in encouraging local and state government investments in support of the development of potential district heating opportunities.
4. The availability of low-cost, long-term financing through the issuance of tax-exempt "district heating" industrial development revenue bonds, would encourage the development of district heating systems by both private sector and non-Federal government sponsors of proposed projects. This results from the fact that many potential district heating projects cannot assure a feasible minimum level of customer heating and cooling demand within their existing communities without violating the "exempt users utility output contract" provisions of Section 103(b) of the I.R.S. Code. In broad terms, the exempt users test is met only if it can be shown that 75% or more of the actual output of a district heating project is sold under long-term contracts to political subdivisions of the States, certain other governmental units or non-profit organizations qualifying under Section 501(c) (3) of the Code.

If district heating systems were included as facilities the financing of which were excluded from the "exempt users test" of Section 103 of the Code, the feasibility

of and tax-exempt revenue bond financing of new and expanded existing district heating systems by both private and local government sponsors would not be impeded by insufficient levels of customer demand, resulting from the required exclusion of privately-owned buildings, beyond the 25% limitation.

SUMMARY

In conclusion, by addressing the major financing barriers discussed above, the Federal government can promote a significant expansion of the market penetration of district heating and cooling, with its resulting local community, private sector and national energy and industrial policy benefits. An appropriate package of Federal policy actions would eliminate several major private and local government financing barriers which in the short run cannot be successfully overcome, even in proposed district heating projects with significant long-run feasibility and energy savings.

Mr. VOLKMER. Thank you very much, Mr. Hills.

We will now proceed with questioning under the 5-minute rule and recognize the gentleman from Michigan, Mr. Dunn.

Mr. DUNN. Thank you, Mr. Chairman.

In looking at Government support, some of the areas that Ms. Procter touched on as well as some of the areas she did not touch on, I am wondering, given the high fixed cost of a district heating system and the difficulty of attracting building owners to it, if we are not as a Federal Government better off concentrating on solving the problems of indoor air pollutants, better piping, making more efficient use of waste energy from electric generating plants, making more efficient use out of solid waste, et cetera, and then saying to our cities, "We have provided this technology. We will provide the tax credits, EDC bonding"—which I think is an excellent use of funds and allows a community to make its own decision, as offered to EDA and the guidelines you get under UDAG which are so highly directive that I find cities and developers doing a project to fit the guidelines rather than doing what is best for their own city and then let cities do it themselves.

If anybody would like to comment on a general direction that the Federal Government should go, versus targeting one particular program, I would be willing to listen. Do you see the distinction I am trying to make?

Ms. PROCTER. Yes. Did your list of Federal Government policies include some form of subsidized financing or not?

Mr. DUNN. Yes, EDC and tax credits, but rather than targeting money toward this particular type of heating system, treat it as a general tax problem as the Administration is talking about doing. Isn't it more efficient for each and every city to make up its own mind?

Ms. PROCTER. Given that the characteristics for success of district heating are very local and include a lot of community support, particularly support of organizations like a chamber of commerce or a downtown executives' association that can help convince building owners to sign up, I think I would agree with you that it is very much a local decision and that the overall Federal decision involves a kind of bet on what the 1990's are going to look like.

If it looks like district heating is likely to play an important role or at least some role in the national energy picture in the 1990's—because of what I mentioned about the relative prices of fuel and chances of fuel escalation—then developing a program that will allow it as an option and providing undirected availability of subsidy probably would make some sense, including in it several other technologies that have the same characteristic of being good long-term bets.

Mr. DUNN. The bill that the Congressman introduced, some of that does fit in with the tax credits the President is talking about. I would support that part of the bill as long as it is all inclusive for anybody who is moving toward some sort of more fuel-efficient type of heating. I think I object to targeting to this one particular industry.

Mayor HOLLAND. My feeling is that it is kind of self-evident targeting because it is the one potentially great means toward self-sufficiency that is simply not being utilized, and I can tell you that we did not find it easy in our case to get the cooperation of the traditional utilities.

Mr. DUNN. Yes.

Mayor HOLLAND. In fact, my feeling was that they did everything they could to stall or even kill the project, so we need all the help we can get to develop this source.

Mr. DUNN. However, I am saying—and I have no idea whether it was the case there or not—that there may be some very logical reasons why they did not do it.

Mayor HOLLAND. They did not give me any.

Mr. TAYLOR. May I—

Mr. DUNN. Yes.

Mr. TAYLOR. I spent yesterday with the Consumers Power Co., in Michigan, looking very, very much at what is going on in Grand Rapids. Grand Rapids is a growing city, being rebuilt in many areas, has a very effective district heating system but it is at a point, if they are going to grow they are going to have to go across the river and a lot of the development is going to be there. They are going to have to find alternate supplies. They are feeding this out of one powerplant. It bothers them.

The one thing that a utility, that a district heating system really needs is continuity of supply: They need little bits of help. They are perfectly willing to make the investment to put in cogeneration equipment in the next powerplant. There is going to be a trash-

burning facility up in the northern part of that city. They are willing to tie in with that.

However, they need, some demonstration. Should they go to hot water? They ask those questions. They also were concerned about, tax concession that they would at least be equitable to the business who, instead of accepting district heating, elects to put in a gas-fired boiler.

He can write that equipment off much quicker than we can write off equipment in the utility. He does not have the regulatory constraints against him that utilities do. Give the utility a fair break on taxes. If there are systems that are not in use because the area is being redeveloped or is torn down, and cannot be utilized, please do not charge the tax on that particular part of our system that is not in use.

These are small concessions but they would turn the tide. This is a willing utility, willing to go ahead, favors district heating, willing to make a little profit and be content with it. However, they need help on not being taxed up to their eyeballs when they perform a simple task such as opening a trench in the street. Little things can mean a lot.

Mr. DUNN. Well, general tax relief is something that I support. I have no objection to that at all.

Mr. VOLKMER. We have a vote, and we will return at 11:30. We have to go vote and we will recess until 11:30.

[Recess taken.]

Mr. VOLKMER. The meeting will come to order.

I will ask a few questions and then we will go to the next panel. Either the good mayor here or Mr. Hills could answer, either one.

The Trenton facility, is that a new generating facility?

Mr. HILLS. Yes. The Trenton project is going to build, as Mayor Holland mentioned, a medium-speed diesel engine, and will sell the electricity from that to the—

Mr. VOLKMER. Yes, but I mean, is your total building and everything else new?

Mr. HILLS. Yes; absolutely.

Mr. VOLKMER. Right from scratch?

Mr. HILLS. The whole system is new. One reason that project still is feasible without having at least an existing power source, the energy source there, is that they are competing against No. 2 oil predominantly as a heating fuel in the boilers in the individual buildings.

St. Paul, which is using a Northern States Power Co., existing downtown powerplant, probably could not do something of that nature because their competition is natural gas.

Mr. VOLKMER. Will they in St. Paul be using the existing utility as a source—working with them, in other words, changing the generators, et cetera—as a source for the heat?

Mr. HILLS. Yes; they are going to buy one smaller plant, own that and run that, and then they are going to run a steam line—really it is debatable at this point whether it is a steam or hot water line—from another Northern States Power Co., plant to the plant that they will own as a backup heat source.

Mr. VOLKMER. Mayor Holland, perhaps what you are doing explains why the utilities were not too agreeable to working with

you. It appears, I assume, that the buildings that are presently there are using electrical energy generated by the existing utility.

Mayor HOLLAND. Well, thanks to a Federal law the public service agreed to sell us what we needed as a basic fuel, gas, to supplement the oil in order to cogenerate.

Mr. VOLKMER. Yes, but I mean, existing right now, your electrical energy that you have in your buildings comes from an existing utility, does it not?

Mayor HOLLAND. Yes; the public service——

Mr. VOLKMER. When your facility is completed you no longer will be purchasing electrical energy from them?

Mayor HOLLAND. Well, certainly not for those buildings.

Mr. VOLKMER. For those buildings?

Mayor HOLLAND. Under the agreement they must purchase from us, in accordance with the highest rate, what we produce and put into their grid.

Mr. VOLKMER. In other words, when you generate electricity you are not going to put it into your buildings directly. You are just going to put it into the grid——

Mr. HILLS. It goes into the pool.

Mr. VOLKMER [continuing]. And then buy back from them?

Mr. HILLS. Well, we will not——

Mr. VOLKMER. I am talking about electrical energy, now.

Mr. HILLS. Not for those, we would not be buying back for those buildings; no.

Mr. VOLKMER. You are going to feed it directly into those buildings yourself, then?

Mr. HILLS. Right.

Mr. VOLKMER. I am talking about electrical power.

Mr. HILLS. No; the powerplant will be selling electricity directly to the utility. There is an arrangement where, if we needed backup at the plant, that we would be supplied that by the utility.

Mr. VOLKMER. However, you will be buying back power from the utility, then.

Mr. HILLS. Only in case we had the generator in the plant shut down for some reason, only as an emergency backup. We will generate our own internal electricity and sell the remainder to the utility, and then sell the——

Mr. VOLKMER. That is what I am trying to get at. You are going to feed, then, the electricity you generate into the buildings which you are also heating.

Mr. HILLS. No.

Mr. VOLKMER. You are not?

Mr. HILLS. No. The electricity will be sold to the utility for its general use.

Mr. VOLKMER. Right.

Mr. HILLS. The buildings will get simply the heating requirements from our system.

Mayor HOLLAND. And the cooling.

Mr. VOLKMER. I will start over again. Maybe we just do not understand each other. Where does the electricity, the power—the electrical power, who are you going to get that from?

Mayor HOLLAND. We are going to buy oil that is——

Mr. VOLKMER. No, no. Who are you going—what is your source—let's say your State office, capitol building, what is going to be the source when this is all finished, what is the source of electrical energy that you are going to get? Whose line is coming into the capitol?

Mayor HOLLAND. Public Service Electric & Gas.

Mr. VOLKMER. Fine. Therefore, you are obtaining electrical energy from them.

Mr. HILLS. Yes.

Mr. VOLKMER. That is what I originally asked about.

Mr. HILLS. Right.

Mr. VOLKMER. What you are doing is, you are selling to them and then buying back from them.

Mr. HILLS. No.

Mr. VOLKMER. You are not?

Mr. HILLS. It is a bit complex. To clarify, we will build a diesel generator, a diesel engine. There will be an electrical generator attached to that diesel engine, so that when the diesel engine runs we will produce electricity.

Mr. VOLKMER. Right. Where does that electricity go? That is what I want to ask you.

Mr. HILLS. We will sell that directly to the utility.

Mr. VOLKMER. Every bit of it?

Mr. HILLS. Except what we need inside our own powerplant.

Mr. VOLKMER. Fine. None of it goes to the capitol and to the office building or the hospital or anything else?

Mr. HILLS. No. We are not going to offset—

Mr. VOLKMER. Now you sent this into this utility grid, right? Now it is gone. Now you have a capitol building over here and it is going to use electricity. Where is that electricity coming from?

Mr. HILLS. From the local utility—

Mayor HOLLAND. From Public Service Electric & Gas Co.

Mr. HILLS. Of which the buildings served by district heating are present customers.

Mayor HOLLAND. However, to the extent that we can supply—

Mr. VOLKMER. However, my point is, you are saying that you are not selling it to a utility and buying it back from a utility.

Mr. HILLS. That is correct.

Mayor HOLLAND. Not for the cogeneration plant purpose.

Mr. VOLKMER. I am not saying that; I am saying for the capitol building.

Mayor HOLLAND. You are right, yes.

Mr. VOLKMER. I am saying for the office building—

Mayor HOLLAND. It goes into their pool and—

Mr. VOLKMER. You are getting it back from the utility.

Mayor HOLLAND. Maybe not what we generate but some other from pool, yes.

Mr. VOLKMER. That is my point.

Mayor HOLLAND. Yes.

Mr. VOLKMER. I will go back again to it: You are going to sell to a utility—I do not know if it is the same utility or not, and then you are buying from—the same one?

Mr. HILLS. In our area, the same one, yes.

Mr. VOLKMER. You have the one, so you are going to sell to them, that utility, into their grid, and then you are going to buy back from them also—I am talking about the buildings that are using that electricity. They are also going to be using the heat.

Mr. HILLS. Yes.

Mr. VOLKMER. Finally.

Mr. HILLS. The buildings will continue to be served by the local utility.

Mr. VOLKMER. Yes.

Mr. HILLS. What we are doing is selling them, in electrical terms, what is called 12 megawatts of power, which is a very small portion of their total requirement.

Mr. VOLKMER. I wanted to get that straight.

I have no further questions.

Jim, do you have any questions?

Mr. SCHEUER. I have no questions.

Mayor HOLLAND. Mr. Volkmer, I would like to make a point while you are here that I made previously, and that is that while DOE has invested over \$1 million in research so far as our project is concerned and has committed another \$450,000 to the grid, and whereas HUD has invested a \$4 million UDAG—which has generated, as you heard, five times that—originally DOE had included \$200,000 to \$250,000 for a center which would be incorporated into the cogeneration plant which would enable visitors to come and see how cogeneration works.

It is my hope that this committee would help us get DOE or HUD or someone to provide that money, especially given the wave across the country of feasibility studies that will be being made, so there will be a point in this country where people could come and see—and we hope to break ground after Labor Day—such a plant, a district heating plant, in operation.

Mr. VOLKMER. We will take that under advisement.

We better really now go on to our next panel because we are running late. I want to thank all four of you for coming and giving us the information from your testimony. It is very enlightening and I am sure we have to answer some problems for the future. Thank you very much.

We will now hear from Mr. Donald Dodge, Deputy Assistant Secretary for Community Planning and Development, Department of Housing and Urban Development, and Mr. Joseph Tribble, Assistant Secretary for Conservation and Renewable Energy, Department of Energy.

Gentlemen, I understand you both have prepared statements. Those statements will be made part of the record following your oral presentations. You can read from them if you wish—it is not necessary—and you can summarize, if you wish to do so. I am sorry about the time constraints.

We will now hear from Mr. Dodge.

Mr. DODGE. Mr. Chairman, if it pleases the committee, Mr. Tribble would like to make the introductory—

Mr. VOLKMER. Fine. That is quite all right. Either one.

**STATEMENT OF JOSEPH TRIBBLE, ASSISTANT SECRETARY FOR
CONSERVATION AND RENEWABLE ENERGY, U.S. DEPART-
MENT OF ENERGY, ACCOMPANIED BY GERALD LEIGHTON,
DIRECTOR OF FEDERAL AND COMMUNITY PROGRAMS**

Mr. TRIBBLE. Mr. Chairman and members of the committee, first I would like to introduce Mr. Gerald Leighton, who is with me. He is the Director of Federal and Community Programs in our office at DOE. In view of the fact that I have been on board only a couple of months, I thought it would be prudent to have someone here who is a great deal more familiar with the details of the programs that we have been involved with.

The Federal Government's program in district heating and cooling is a cooperative effort between the Department of Energy and the Department of Housing and Urban Development. Mr. Donald Dodge, the Deputy Assistant Secretary of Community Planning and Development of HUD, and I have submitted a rather lengthy joint statement for the record, and we would like to summarize that statement for you. Mr. Dodge and I have agreed that I will discuss some of the technical aspects of the district heating systems and Mr. Dodge will then address the institutional aspects.

The term "district heating" is used to identify a means whereby thermal energy from a central source is distributed to serve the needs of users in the adjacent area. The medium for distribution of thermal energy may be steam, hot water, or chilled water. The central energy source may be a steam boiler, the extraction or exhaust from a steam turbine, the exhaust heat from a diesel engine or a combustion turbine, or it may be from geothermal or industrial waste heat. Chilled water is usually from an absorption-type chiller.

The steam or hot or cold water from the central source is distributed through a piping system to the users, which may be industries needing process heat, a building complex, or residences. Economics dictate that the areas served have comparatively dense energy demands.

Early in the 20th century, district heating was an economical way of using the exhaust steam from steam engines. The advent of condensing steam turbines and inexpensive oil and natural gas changed these economics. Now that these fuels are no longer expensive, attention again is turning to this technology.

In the northern European countries, where energy costs have been relatively high for many years, district heating and cooling systems are not unusual. There hot water systems predominate, and for good reason. Hot water systems can, of course, use heat from all the sources mentioned previously. In addition, hot water piping systems, controls, and metering are simpler than in steam systems, and pumped water can serve a wider area.

Recent higher fuel prices have also revived an interest in cogeneration of electric power and process heat. Cogeneration and district heating and cooling are complementary means of increasing the efficiency of energy utilization. To these can be added the use of urban waste as fuel, and another community need is met, the disposal of urban waste.

As one might expect, it is generally less expensive to establish such installations when communities are being developed than to

retrofit, although retrofit is economically feasible in some cases. While the technology is largely a matter of engineering design, certain institutional relationships have inhibited the widespread adoption of district heating and cooling.

However, before Mr. Dodge discusses these, I would like to review briefly the recent activities of the Federal Government in the field of district heating and cooling. The district heating and cooling program was initiated in 1975 by one of DOE's predecessors, the Energy Research and Development Administration. Extensive analyses and assessments of the legal, regulatory, financial, and other institutional issues were performed. The potential market penetration, scarce fuel savings, and community impacts have been assessed.

Based on that initial work, a demonstration program of seven competitively selected, site-specific projects was initiated. The object of the demonstration program was to determine whether and under what circumstances site-specific applications of district heating and cooling would be feasible.

At the same time several small geothermal district heating and cooling demonstrations were initiated. The Nuclear Technology Office, in cooperation with the Community Systems Division of Conservation, initiated an assessment of the potential of a nuclear-based district heating and cooling system in a large metropolitan area, Minneapolis-St. Paul.

In late 1979, the site-specific studies confirmed that significant energy and economic benefits would accrue from development of district heating and cooling. In 1980, a comprehensive district heating and cooling analysis was initiated. A collaborative effort of the Offices of Conservation, Nuclear Energy, Resource Applications, Policy and Evaluation, and the Economic Regulatory Administration, in cooperation with other Federal agencies, produced a draft document which has been widely circulated, redrafted, and is still under review.

An Interagency District Heating Coordinating Group was formed at the Assistant Secretary level in October of 1980. All new major activities since then have been in cooperation with the Department of Housing and Urban Development. HUD and DOE agreed to a cooperative program for the project development of district heating and cooling in a large number of distressed cities.

The cooperative program at that time envisioned three phases of development: assessment, engineering and preconstruction, and implementation. HUD issued a request for cooperative agreements covering the first phase. It was planned that DOE would subsequently issue a request for cooperative agreements covering the second phase, engineering and preconstruction.

The HUD/DOE solicitation covering the first phase was budgeted in fiscal year 1981 at \$1.5 million, with DOE providing \$750,000 of that amount. DOE is also contributing \$500,000 in technical assistance in this phase of the work. In response to the HUD/DOE request, over 600 communities expressed interest, 111 communities submitted proposals, and 28 of them were selected for negotiation.

In contrast to the policies just described, it is the policy of this administration to not participate in demonstration programs where the technology is well known. Since technical issues do not appear

to be a major factor impeding district heating and cooling, the Department of Energy does not intend to be involved in financing this activity. DOE does expect to continue to make available, to anyone who has a need, the knowledge that we have gained on the subject. We further expect to encourage and help interested parties to work together toward utilization of district heating and cooling.

In addition to this bilateral district heating and cooling project development effort, DOE and HUD have been participating with other Federal Government agencies, including Treasury, the Environmental Protection Agency, the Department of Commerce, the Department of Defense, the Veterans Administration, the General Services Administration, Health and Human Services, all members of the Interagency District Heating Coordinating Group mentioned earlier.

The goal of this group has been to promote the coordination of programs and policies on a Federal Government-wide basis for district heating and cooling. The short-term objective of this group was to produce a district heating and cooling policy paper for consideration by the White House in mid-year 1981. As of this time, the discussion paper has been written, preparatory to writing the policy options paper.

There is no question that district heating is feasible from an engineering point of view. Its use is a question of economics. We have heard testimony that district heating is in use, primarily where energy is even more expensive than it is here in the United States. It is becoming economical here, particularly in the frost belt. We believe that it is a very usable technology and will be put to use when and where it becomes economical. We do not believe that the Federal Government should attempt to force these economics through the expenditure of large sums of money.

Mr. Chairman, this concludes my summary statement, and I would yield to Mr. Dodge or to questions, whichever is your pleasure.

[The prepared statement of Mr. Tribble follows:]

STATEMENT OF

JOSEPH J. TRIBBLE

ASSISTANT SECRETARY FOR CONSERVATION AND RENEWABLE ENERGY

U.S. DEPARTMENT OF ENERGY

BEFORE THE

HOUSE SCIENCE AND TECHNOLOGY COMMITTEE

ENERGY DEVELOPMENT AND APPLICATIONS SUBCOMMITTEE

JULY 23, 1981

Mr. Chairman and Members of the Subcommittee:

The Federal Government's program in district heating and cooling is a cooperative effort between the Department of Energy and the Department of Housing and Urban Development. Mr. Donald G. Dodge, Deputy Assistant Secretary for Community Planning and Development of the Department of Housing and Urban Development, and I have submitted a rather lengthy joint statement for the record and we would like to summarize that statement for you. Mr. Dodge and I have agreed that I would discuss some of the technical aspects of a district heating system and Mr. Dodge will then address the institutional aspects.

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Early in the 20th century, district heating was an economical way of using exhaust steam from steam engines. The advent of condensing steam turbines and inexpensive oil and natural gas changed these economics. Now that these fuels are no longer inexpensive, attention is again turning to this technology.

In the northern European countries where energy costs have been relatively high for many years, district heating and cooling systems are not unusual. There, hot-water systems predominate and for good reason. Hot-water systems can, of course, use heat from all the sources mentioned previously. In addition, hot-water piping systems, controls, and metering are simpler than in steam systems and pumped water can serve a wider area. Recent higher fuel prices have also revived interest in cogeneration of electric power and process heat. Cogeneration and district heating and cooling are complementary means of increasing the efficiency of energy utilization. To these can be added the use of urban waste as fuel and another community need is met - disposal of urban waste. As one might expect, it is generally less expensive to establish such installations when communities are being developed rather than to retrofit, although retrofit is economically feasible in many cases. While the technology is largely a matter of engineering design, certain institutional relationships have inhibited the wide spread adoption of district heating and cooling. However, before Mr. Dodge discusses these, I would like to review briefly the recent activities of the Federal Government in the field of district heating and cooling.

The district heating and cooling program was initiated in 1975 by one of DOE's predecessors, the Energy Research and Development Administration. Extensive analyses and assessments of the legal, regulatory, financial and other institutional issues were performed. The potential market penetration, scarce fuel savings and community impacts have been assessed. Based on that initial work, a demonstration program of seven competitively selected, site-specific projects was initiated. The object of the demonstration program was to determine whether and under what circumstances site-specific application of district heating and cooling would be feasible. At the same time several small geothermal district heating and cooling demonstrations were initiated. The Nuclear Technology Office in cooperation with the Community Systems Division of Conservation initiated an assessment of the potential of a nuclear-based district heating and cooling system in a large metropolitan area (Minneapolis/St. Paul). In late 1979, the site-specific study confirmed that significant energy and economic benefits would accrue from development of district heating and cooling. In 1980 a comprehensive district heating and cooling analysis was initiated. A collaborative effort of the Offices of Conservation, Nuclear Energy, Resource Applications, Policy and Evaluation and the Economic Regulatory Administration, in cooperation with other Federal agencies, produced a draft document which has been widely circulated, redrafted, and is still under review. An Interagency District Heating Coordinating Group was formed at the Assistant Secretary level in October of 1980. All new major activities since then have been in cooperation with the Department of Housing and Urban Development.

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In contrast to the policies just described, it is the policy of this Administration to not participate in demonstration programs where the technology is well known. Since technical issues do not appear to be a major factor impeding district heating and cooling, the Department of Energy does not intend to be involved in financing this activity.

DOE does expect to continue to make available, to anyone who has a need, the knowledge we have gained on this subject. We further expect to encourage and help interested parties to work together toward utilization of district heating and cooling.

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In addition to this bilateral district heating and cooling project development effort, DOE and HUD have been participating with other Federal government agencies including Treasury, the Environmental Protection Agency (EPA), the Department of Commerce (DOC), the Department of Defense (DOD), Veterans Administration (VA), General Services Administration (GSA) and Health and Human Services (HHS) in the Interagency District Heating and Coordinating Group (IDHCG) mentioned earlier. The goal of this group has been to promote the coordination of programs and policies on a Federal Government-wide basis for district heating and cooling. The short-term objective of this group was to produce a District Heating and Cooling Policy Paper for consideration by the White House by mid-year 1981. As of this time, the Discussion Paper has been written, preparatory to the writing of a Policy Options Paper.

Mr. Chairman, this concludes my summary statement and I now yield to Mr. Dodge.

Testimony
of
Joseph J. Tribble
Assistant Secretary for Conservation and Renewable Energy
U. S. Department of Energy
and
Donald G. Dodge
Deputy Assistant Secretary for Community Planning and Development
U.S. Department of Housing and Urban Development
before
U. S. House of Representatives
Committee on Science and Technology
"District Heating and Cooling: Current Status and Future Prospects"
July 23, 1981

We wish to thank the Committee for this opportunity to discuss with you the subject of District Heating and Cooling. This statement specifically addresses the questions posed in the letter from Congressman Fuqua.

Introduction

The use of district heating and cooling is a subject which is simple in concept from an engineering point of view and uses existing technology. District heating and cooling requires one or more sources of thermal energy, a distribution network of pipes to carry the thermal energy to many users, heat exchangers at the using end, and in some instances, return pipelines. It is very analogous to the familiar electrical system we have in place. The source heat exchangers can be likened to the electrical generating plant and switch yard; the thermal distribution system piping is analogous to the wires used for transmission and distribution and the user heat exchangers can be compared to the building service entry of the electrical system. The piping carries hot water or steam to the user.

One group of initial implementers of DHC are the existing utility companies. They are, of course, energy companies and provide one or more forms of energy to users within a political jurisdiction. However, they are not the only possible implementors. Depending on local conditions, including State and local regulations, it is possible that DHC could be implemented by third parties. Within any community, the key issue is to bring the interested parties together, the utility company, local officials, the business community and consumers, so that all work together to define and work toward a common goal. Given that overall framework, one that places the DHC effort in a primarily institutional environment, we will now address the specific questions posed by the Chairman.

District-Heating-and-its-Potential

A district heating and cooling system consists of one or more central heat generation facilities and a piping network designed to carry hot and/or cold water (and/or steam) to meet community energy needs. District heating and cooling (DHC) systems serve hospital complexes, educational facilities, residential and industrial complexes, as well as entire central business districts and other densely populated areas.

Significant benefits accrue to the local community from the utilization of district heating and cooling systems. DHC systems:

- o enhance industrial and urban development potential by providing minimum energy costs for consumers;
 - o create long-term, private sector job opportunities;
 - o permit maintenance of environmental quality by replacing uncontrolled individual boilers with central facilities which are of such scale to allow for economic control of emissions.
- The private sector can benefit from the use of district heating and cooling:
- o DHC system create opportunities for utilities (or third parties) to diversify and expand into new markets, as well as retain existing urban energy markets.
 - o The systems provide significant new markets for energy conversion equipment of all types, as well as for steel piping, plastics and insulation.

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Finally, district heating and cooling systems address several important national economic concerns:

- o Efforts for industrial revitalization are boosted by the extensive private sector and utility investments required for such systems.
- o The use of DHC also may make it possible for industry to locate or expand where it otherwise might not be feasible given environmental standards.
- o DHC systems in declining central business districts or industrial areas will make them more attractive to potential investors and enable them to once again become self-sustaining communities.
- o Finally, the fuel efficiency and substitution effects of district heating and cooling can mean reductions in U.S. reliance on foreign oil and the strategic vulnerability associated with this continuing dependence.

Current investment in district heating and cooling in the United States, however, is not occurring at a rapid rate. In many European countries and the Soviet Union, district heating and cooling has developed rapidly since the 1950s.

In West Germany, for example, government programs are leveraging extensive private sector investment. West Germany and the U.S. are similar in terms of climate, private ownership of electric and gas utilities, and a political structure involving federated States. It is reasonable to estimate that the U.S. has the potential for developing DHC systems to the extent that West Germany has.

Significant impediments to market penetration exist, however, as a result of Federal policy and State regulatory practices.

Actions that government at all levels could take include:

- o removing regulatory barriers which currently impede DHC development;
- o addressing financing barriers by equalizing tax treatment, or by providing tax incentives, loans or loan guarantees;
- o implementing demonstration projects in cities and in Federal facilities as the Department of Energy is now doing;
- o providing technical, legal and regulatory advice and assistance to potential investors.

Bringing the full benefits of district heating and cooling to the U.S. requires understanding and coordination among diverse public and private sector decision makers. Stable and consistent Federal and State policy frameworks are needed to remove the barriers to private participation in district heating and cooling ventures and provide support and to stimulate confidence in investments in modern district heating and cooling in the U.S. energy market.

District heating and cooling (DHC) systems provide thermal energy services to a community. They should not be considered a fuel form or a competing alternative to oil or natural gas; rather, they are flexible energy distribution systems that can take heat from any number of fuel sources and deliver it to many different customers.

A district heating and cooling system consists of one or more central heating complexes and a piping network designed to carry hot and/or cold water to meet community energy needs. Steam has also been used to transport heat. Cooling services can be provided directly in a district system by distributing chilled water in a network or distributing steam to power individual steam absorption chillers. Steam systems are limited to smaller service areas and are less flexible than hot water systems but may be attractive in the U.S. where air conditioning is significant and for satisfying industrial loads. Because the piping network transports heat and not fuel, virtually any available heat source can be incorporated into the district heating and cooling system, including heat from non-scarce fuels (coal, nuclear, urban waste), natural sources (solar, geothermal, groundwater, atmosphere), manufactured sources (industrial waste heat and synfuels); or waste heat from the generation of electricity.

Communities -- including cities, suburban developments, and special-purpose centers -- can use district heating and cooling systems as important components of their individual economic development and energy strategies. The role of district heating and cooling systems in a specific community depends on local needs, physical characteristics, and available resources. District heating and cooling systems may be small-scale -- such as hospital complexes, educational facilities, industrial complexes, shopping centers, or residential or commercial developments -- or large scale -- such as entire downtown or metropolitan areas.

Benefits from the adoption of district heating and cooling for communities exist in enhanced industrial and urban development potential, increased job opportunities, energy price stability, and maintenance of environmental quality.

- o Creates Job Opportunities in Urban Areas

The capital investment necessary for district heating and cooling systems provides long-term, private sector job opportunities in construction, operations and maintenance. Urban residents, including low skilled workers, are expected to be beneficiaries of these jobs.

Recent analysis has shown that district heating and cooling construction can create more direct jobs, including semi-skilled jobs, per dollar of construction investment than energy supply options. (As shown in Figure 1.) The construction employment will not be short term. The nature of district heating and cooling development requires phased system expansion and investment similar to the construction of electrical distribution and natural gas lines.

- o Reduces Uncertainty and Instability in Energy Pricing

The implementation of a DHC system in an urban area can aid in attracting new or maintaining industrial and commercial activity. Such systems provide a reliable, cost stable supply of energy which is key to the economic well being of these sectors. This is achieved by a capital investment in the system to replace operating costs for purchasing new energy supplies over time. The capital investment is fixed and the capital charges known. The fuel component of energy delivered by a DHC system is a minor part of the cost, and as

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important, as noted earlier, once the piping is in place, the delivered energy is independent of the source. A district heating network initially providing hot water from a central residual oil fired boiler could for example, generate the hot water from a boiler fueled with coal, an incinerator with waste heat and so forth. The pipes transport hot water, steam or chilled water regardless of how they were generated.

o Permits Maintenance of Environmental Quality

Many of the nation's urban areas cannot presently meet Federal air quality standards. As district heating and cooling systems are phased in, central generation facilities will replace individual boilers. This replacement will result in significant improvements in air quality. (See Figure 2.) Preliminary analyses indicate that it may be possible for utilities to switch to coal for district heating and cooling with no significant deterioration in air quality.

By the recovery of industrial and electric utility heat loss through cogeneration, district heating and cooling can also substantially reduce thermal pollution. Likewise, the use of urban waste as a fuel source for a district heating and cooling system reduces the problems associated with urban landfill operations.

Adoption of district heating and cooling in communities nationwide presents new opportunities for private enterprise, and creates opportunities for utilities to expand markets and retain urban energy markets by increasing efficiency (and thereby controlling energy cost increases).

o Creates Opportunities for Energy Entrepreneurs

Existing district heating and cooling systems in the United States be utilized in developing new energy technologies. As new technologies mature they can be incorporated into an existing district heating and cooling system in a relatively low-risk situation. District heating and cooling systems, in effect, become a market mechanism permitting easy entry for new suppliers and new users.

District heating and cooling systems can be designed around existing heating and cooling equipment. Therefore, they can provide significant markets for energy conversion equipment of all scales, waste and heat recovery systems, and specialized equipment such as heat pumps and heat exchangers. They would also provide huge markets for the steel piping, insulation, and plastics industries.

o Permits Utility Market Expansion and Diversification

Rapidly rising energy prices in recent years have affected the demand for utility services. As conservation has become a reality, many electric utilities have curtailed expansion plans, and existing plant capacity is often underutilized in many service areas. Using electrical generation plants for cogeneration district heating and cooling not only improves plant efficiency but significantly increases the use of plant capacity as well.

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In rapidly growing areas of the country, utilities may not be able to meet, in a timely fashion the growing demand quickly enough. District heating and cooling systems linked to small, modular cogeneration systems can be used to alleviate capacity shortages, as well as providing by-product heat. Other areas of the nation may be faced with little growth in electric demand, and the investor held utility must look to opportunities for new, profitable markets. District heating may provide such as opportunity.

Of a more general nature, implementation of DHC has the following national benefits:

o Boosts Industrial Revitalization Efforts

District heating and cooling offers business opportunities for developing significant new markets for energy conversion, waste and heat recovery, specialized heat pump equipment, and steel, insulation and plastics products. District heating and cooling also offers utilities and energy suppliers extensive opportunities for developing new markets, as well as preserving and strengthening current urban energy markets.

o Develops Self-Sustaining Urban Economies

Encouragement of the adoption of district heating and cooling in commercial and industrial areas of our cities and towns as part of new strategies for community development could also have significant economic benefits. Older towns, cities and suburbs that do not have reliable sources of energy for commercial and industrial activity at reasonably stable prices cannot maintain their economic base.

The presence of the district heating and cooling system in a central business district of an industrial area should make the area more attractive to potential investors and could help stabilize, if not revitalize, many older, declining areas. These areas would eventually depend less on financial support and could once again become self-sustaining, relieving the need for State, local and Federal remedial action to address issues arising from the loss of urban economic vitality.

o Reduces Scarce Fuel Consumption and Reliance on Imported Oil

It is estimated that about one quarter of the total energy consumption in the U.S. is used to heat and air-condition buildings and to heat domestic and service water. These uses amount to about 20.5 quads of the 78 quads of energy the U.S. will consume this year. DHC can readily provide the services for one third of the demand while simultaneously displacing 5 Quads of scarce fuels.

Reductions in scarce fuel consumption can mean reductions in U.S. reliance on foreign oil imports and the strategic vulnerability associated with this continuing dependence. Reducing oil imports also brings balance-of-trade advantages to the U.S.

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o Provides Employment Opportunities Where They Are Needed Most

The employment benefits of district heating and cooling investment--long-term, semi-skilled employment opportunities concentrated in urban areas--can have a significant impact on the national employment outlook. Providing these employment benefits in the areas where persons are now unemployed will reduce the drain on Federal, State and local budgets caused by unemployment and other assistance programs. (See Figure 1.)

o Achieves Environmental Goals While Permitting Continued Growth

Environmental benefits result from increased district heating and cooling use by providing significant improvements in air quality in industrial areas, and by decreasing thermal pollution (through the use of cogeneration) and waste disposal problems, the use of district heating and cooling may make it possible to expand or locate new industry in urban areas where it otherwise might not be feasible given environmental standards.

Potential Development of District Heating and Cooling

In the U.S. the first move toward "district" heating began when byproduct steam induced in small, centrally located electrical plants was piped to heat nearby downtown buildings rather than vented as waste. By 1910, there were an estimated 150 local utility companies providing local heating in this manner.

This early growth in steam systems, however, was slowed by technological change in the electric utility industry. Improvements in electrical generation and transportation technology allowed larger new plants to be located farther away from developed areas. Utility companies began to close the small generating plants that had been so favorably located for serving as suppliers of district heat.

As suppliers of inexpensive byproduct steam disappeared, thermal systems that had started as a complementary service to electrical generation had to be justified by the characteristics of the heating market alone. The early systems were dependent on a single fuel and usually a single plant which severely limited their adaptability. Oil and natural gas began to penetrate market previously serviced by large-scale district heating systems.

Coupled with very low-cost energy in all forms, these events spelled the demise of district heating in the U.S.

Statistics compiled by the International District Heating Association in 1979 show that 44 steam-supply companies are currently active in the U.S., each serving multiple customers. Educational facilities, health complexes, military bases, and Federal facilities operate on-site district heating systems as well.

Conditions for district heating and cooling in the United States can be sharply contrasted with conditions in West Germany, Scandinavia, and Russia, where district heating developed rapidly after 1950, as shown in Figure 3.

European systems tend to have larger service areas than in the United States and are able to serve lower density regions. In addition, many European systems are designed to integrate urban waste as a fuel source, the Paris urban waste/district heating network being the prime example.

Four factors stand out in assessing the European success in this area:

1. European countries faced higher energy costs and scarce petroleum supplies long before the United States and have adopted aggressive policies to minimize the impact of these costs on their economic development.
2. District heating growth has been made possible by a partnership between business and local government, working within a stable policy framework provided by the government. Due to the capital intensive nature of district heating and the attendant need for careful investment planning, neither the public nor the private sector alone could have achieved the success the Europeans have enjoyed in this area through a mixed economy approach.
3. Investment, both public and private, in energy technologies in European countries has been consistent with the energy savings potential. France, for example, has recently launched a major program to accelerate the displacement, through district heating, of all oil used now for forms of heat.
4. A technological difference between U.S. and European systems is the use of steam vs. hot water to distribute heat. Most U.S. facilities today are steam systems developed in an earlier era. Hot water is a better medium for transporting heat for relatively long-distance district heating because pumps can be installed along the transmission pipes to move the hot water. A district heating system in Denmark for example, will pump hot water from a nuclear-powered generating plant to a service area 60 miles from the heat source.

The United States energy profile contains similarities and differences compared to the European one, with West Germany providing perhaps the closest comparison.

Many of our northern cities have climates and heating loads similar to those in West Germany. In addition, the West German political and institutional framework is similar to that of the United States in that it involves federated States and privately owned electric and gas utilities.

West Germany has one of Europe's most ambitious expansion programs for the use of district heating over the next two decades. District systems will meet fully 25 percent of Germany's heating demands by the year 2000. In Germany's industrial heartland they have built and are expanding a "thermal grid" which connects major cities to base loaded cogeneration plants.

While at least one country has provided major government assistance, many European countries owe their success to the fact that the district heating investments are jointly planned and implemented by the private sector and their governments.

The West German program, which has as a goal to increase the percentage of total space heating served by district heating from the present 7 percent to 25 percent by 1990, draws support from two other programs: (a) 7.5 percent

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government participation in facility modification to permit the use of cogeneration, oil-displacing coal, or industrial waste heat, and (b) a fund giving either a 25 percent subsidy or a 10 year write-off for the equipment for district heating connections to buildings. Apart from the financial commitments to district heating implementation, the program involves the use of innovative institutional mechanisms to facilitate implementation.

When the subsidies to district heating and cooling by the governments of Northern Europe are considered, one should also consider the amount of taxes these governments impose upon petroleum products. (See Table I.)

U.S. Potential for District Heating and Cooling

A review of recent U.S. experience with district heating and cooling systems indicates that the situation can be characterized as follows:

1. Older large scale systems have lost customers who took advantage of cheaper supplies of oil and natural gas to install individual furnaces in the 50's and 60's.
2. Newer, small scale "on-site" systems built to take advantage of formerly cheap supplies of oil and natural gas are now experiencing difficulty due to recent spiralling fuel costs.

Conditions, however, are developing that indicate a change in market parameters favoring district heating and cooling development:

- o Large urban centers are demanding decreased reliance on oil and gas due to escalating and uncertain prices and curtailment experiences.
- o Decontrol of oil and gas prices will make alternative energy supply systems more attractive.
- o Several characteristics of modern district heating and cooling systems are attractive to consumers: a hookup is simpler, safer, and more reliable and requires less maintenance and repair than individual furnaces and boilers.
- o Some progressive utility companies are beginning to explore the receptivity of regulatory commissions to alternative profit centers that include district heating and cooling systems as new business ventures.

Because of these changes, a number of cities are beginning to plan for developing and expanding district heating and cooling systems, such as:

- o Detroit, MI. - Detroit Edison, owner of an existing steam system, plans to add an urban waste facility and retrofit an existing coal-burning power plant to provide both steam (for process heating needs) and hot water (for space heating needs). City of Detroit and Detroit Edison are working together closely.
- o Minneapolis - St. Paul, MN. - The District Heating company of St. Paul, a private, not-for-profit corporation, plans to retrofit an existing coal-burning power plant for cogeneration, with a hot water distribution network serving downtown St. Paul, and ultimately the metropolitan Twin Cities area.
- o Piqua, OH. - The City of Piqua plans to retrofit the existing coal-burning municipally-owned power plant for cogeneration, with a hot water distribution network in the downtown commercial area.
- o Bellingham, WA. - The City is currently assessing the use of industrial waste heat from an aluminum plant to supply energy for a hot water district heating system.

- o Fairbanks, Alaska - The City is expanding its municipally-owned steam district heating system with a hot water cogeneration system serving a major portion of the city's commercial and residential area.

In addition, many major cities are planning to assess the opportunities for developing district heating and cooling in their communities. A joint solicitation for proposals announced by HUD and DOE on October 17, 1980 invited cities, States, and other interested entities to apply for \$1.5 million of financial aid to help 28 of them complete work necessary before undertaking the final design and construction of district heating and cooling projects. One hundred eleven responses were received, which would indicate a high level of interest in district heating and cooling. Table II summarizes the characteristics of the 28 projects.

A market forecast estimating the potential penetration of district heating and cooling in the United States has been developed to analyze the market potential for systems using cogeneration of electricity for residential and commercial applications. The model is only able to analyze the residential and commercial markets and excludes all industrial process heat requirements. Even with just residential and commercial markets, district heating is still sufficiently cost-effective to save 1.5 quads of scarce fuels per year by the year 2005. Adding service to potential industrial customers, as well as commercial and residential cooling services, would be expected to increase these penetration estimates substantially.

Despite the many advantages of district heating and cooling and its dramatic success in Europe and Russia, several factors act to impair district heating and cooling market potential.

Factors Impairing the Use of District Heating and Cooling

There have been many barriers to district heating and cooling. Among them have been cost, consumer preference, Federal actions (or inaction), and State regulatory functions. They have eliminated potential markets, given price advantages to competing energy sources, and at times barred the use of innovative techniques to reinvigorate the district heating and cooling industry.

- o The 1949 National Housing Act became a tool for rehabilitating commercial and industrial areas, and through it large areas that might potentially be served by district heating and cooling systems were cleared. New buildings were constructed utilizing the cheapest fuels available at that time and/or the lowest first cost systems.
- o Many of the groups whose cooperation is needed in order to implement district heating and cooling (i.e., utilities, investment firms, municipalities, public service commissions) are inexperienced in working with one another, and this initially inhibits cooperative ventures.
- o Oil and gas have, in the past, benefited from low regulated prices which have given them advantages over construction of district heating and cooling systems.
- o In the late sixties and early seventies, environmental regulation forced many district heating systems to incur greater costs by switching to low sulfur fuels. More recently, the Fuel Use Act has prohibited district heating system central stations from burning natural gas, yet has allowed gas companies to extend service to industrial buildings in district heating service areas.

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- o Regulatory commissions have in the past discouraged the use of innovative financing techniques and tax incentives for regulated energy services. Even in cases where commissions approved innovative approaches to energy service supply, the allocation of the resulting benefits between investors (profits) and customers (lower rates) has been uncertain. This kind of uncertainty inhibits the use of innovative techniques that could benefit both companies and customers and repels investors.

Commissions still dispute how the benefits of Investment Tax Credits, (ITC), and accelerated depreciation should be shared between customers and companies. Despite Congressional direction for treating the ITC in a manner that allocates these benefits to both investor and consumers, some Commissions have insisted upon passing through all the benefits of the ITC to the consumer.

The concern of the Commissions with end-user prices also makes it difficult to partition utility services by their economic characteristics. Designing viable district heating systems, for instance, requires configuring service areas with characteristics that allow maximum utilization of plant capacity. This requires the staged development of a system, which must initially restrict service to facilities within a well-defined area. This economic imperative clashes with most State utility codes containing statutory mandates to provide service.

Another important impediment to district heating and cooling development is the lack of widespread information concerning the costs and benefits of district heating compared to other supply technologies. District heating and cooling must have the confidence of potential investors and users alike.

Although a specific Federal course of action has not been defined to accelerate implementation of District Heating and Cooling, many activities have been initiated and moved forward as determined by available resources.

Review of DOE Activities

Generic work on district heating and cooling started from the early days of the Energy Research Development Administration, the predecessor of the Department of Energy. The early work concentrated on studies, analyses and assessments of the potential for scarce fuel displacement evaluation of the state of the art and barriers to implementation. The early generic work was to establish the framework, the parameters, the issues, the opportunities and the potential of district heating and cooling. The work was performed by the Argonne and Oak Ridge National Laboratories assisted by a variety of other institutions such as NBS, universities, research centers and consultants.

One of the early findings of our assessment work was that legal and regulatory questions were common and prominent for each and every district heating and cooling application. A systematic State-by-State legal and regulatory analysis of district heating and cooling has been performed through a consortium of legal, regulatory and engineering groups, and reports covering the fifty States have been produced. Through this work the most frequently recurring questions in all 50 States were, "Will I be regulated?", "What is my legal responsibility to serve?"

Financing is very important for the success of district heating and cooling systems which are typically capital intensive, negative cash flow in the beginning and require relatively long payback times. Extensive work has been performed and several reports have been produced on innovative financing mechanisms and approaches for district heating and cooling.

Technology evaluation reports on the major existing and emerging technologies that are suitable for district heating and cooling systems were produced covering components and subsystems for the central plant (e.g. boilers, turbines, engines), the distribution networks (e.g. piping, trenching) and end-use equipment (e.g. heat exchangers, absorption chillers). These technology evaluation reports are suitable for both the researcher as well as the practicing professional in the area of district heating and cooling. Computerized programs for the analysis, evaluation and design of a variety of combinations of technologies for district heating and cooling were developed in order to simplify, shorten and increase the accuracy of the evaluation and assessment process that is required for each district heating and cooling application. With the computerized tools that have been developed, in conjunction with standard handbooks and design manuals, we can expect that the time and cost would be reduced to a fraction of the present requirements. Computerized programs for preliminary assessments and feasibility analysis, detailed economic analysis, simulation of operation for a variety of central plants and routing/sizing of distribution networks have been developed and debugged.

The District Heating and Cooling Handbook which is the main reference book for engineers, operators and managers of systems, has been published by the International District Heating Association, (IDHA), over 30 years ago. IDHA in cooperation with the Argonne National Laboratory, is updating the handbook. Revisions include the hot water system technology, the computerized tools described above and a variety of technology developments applicable to district heating and cooling. Through this handbook it is expected that the practicing professionals, the researchers and the managers of district heating and cooling systems will have a reference similar to the American Society of Heating, Airconditioning and Refrigerating Engineers Handbooks for the buildings area. The IDHA Handbook will be in three volumes with the first volume expected to be issued this year and the other volumes shortly thereafter.

Extensive systems analysis work has been performed by Argonne National Laboratory covering district heating and cooling utilizing build-up heat pumps and natural heat sources such as lakes, rivers, urban waste streams, underground water, sea water, etc.. Seven different configurations have been studied and analyzed for technical, environmental, economic and energy conservation potential.

A program environmental assessment document has been produced covering the variety of technologies and combinations that could be employed for district heating and cooling applications for various settings and sites (urban small and large, suburban small and large). This document is now undergoing internal review and is expected to be issued within the year.

The potential market, benefits, costs, etc. of district heating and cooling for the nation and the major regions of the country has been the subject of an extensive DOE effort. Several reports have been produced on the market potential, cost and benefits of district heating and cooling under various economic and energy scenarios. Analytical tools have been developed that

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assess the potential of existing power plant near cities that could be converted into cogeneration plants and could be retrofitted with a distribution network to serve the cities. The work continues at Argonne National Laboratory to expand the analytical capabilities to cover large industrial plants and other resources such as low temperature natural and waste streams that could be utilized with large build-up heat pumps for district heating and cooling.

The demonstration work started shortly after the early results were known of the generic work as described above. The demonstration work covering small, medium and large applications had as its main purpose to demonstrate the findings and the results of the extensive analytical work. Most of the demonstration work was initiated through competitive solicitations. Typically, a team consisting of community leaders, utility company representatives, developers and large consumers were under contract to DOE to pursue the application of district heating and cooling in their community. Typically, each of our demonstration activities had some very specific goals in addition to the general objective of demonstrating that district heating and cooling is beneficial to the community as well as the individual participating entities. DOE's participation was very prominent up front covering 80% to 100% of the cost of the preliminary feasibility and assessment work which was perceived to be the high risk portion and falls rapidly off to only a few percent of the first phase of construction. Typically, our financial participation for an entire project would be about 2%. We provided, in addition to the up front financial assistance, technical assistance through Argonne National Laboratory and Oak Ridge National Laboratory in the areas of technology, engineering, financing, regulation and organizing. This technical assistance utilized the results of previous analyses which thus minimized waste for each specific project. Such assistance benefited the program by providing data to update and upgrade our tools and methodologies.

In the small scale applications three Grid-Connected Integrated Community Systems, (Grid-Connected ICES) are now under construction: the Georgetown University Fluidized Bed System, also under construction, and the Mine Water Heat Pump Integrated Community Energy System in Scranton, Pennsylvania, in the preconstruction stage. The Grid-Connected ICES effort included those at Trenton, NJ., University of Minnesota and the Clark University. The main objective of this demonstration effort is to show that a commercial cogeneration system serving an urban subarea can operate on thermal demand and produce electricity as a byproduct and so achieve the maximum benefits for energy and economics achievable through cogeneration. The typical commercial cogeneration systems up to now (called Total Energy Systems) must be operated to meet electrical demand. For a good deal of time through the year they cannot take advantage of the thermal energy produced. These Total Energy Systems while they produce two products (electricity and heat) theoretically very efficiently, do not utilize their product to their full extent, achieving a seasonal efficiency in the range of only 50% to 60%. The Grid-Connected ICES concept utilizes both products throughout the year to their full extent thus achieving the highest permissible by technology seasonal efficiencies. The main consideration for this excellent operating concept is the establishment of the appropriate cooperation between the cogenerator and the local utility company. In order for the Grid-Connected ICES to work, an equitable system of debits and credits has to be established between the cogenerator and the local utility company which will govern the exchange of electricity between the two. The Grid Connected ICES activity has contributed to the formulation of the Public Utility Regulatory Policies Act regulations for cogeneration. This activity was initiated in FY 1976. Twenty-two proposals were received and five

were selected for the preliminary feasibility analysis. Two of the five, the Health Educational Authority of Louisiana (HEAL) and the Indianapolis ICES were dropped after the first phase for institutional reasons. The other three continued their efforts and each one of them is now in construction. The technology utilized is the Grid-ICES concept varies widely as well as the size of the systems. It is important to note that the demonstrations are not for particular technologies but for a particular operational mode of commercial cogeneration utilizing any technology. The University of Minnesota is using coal boilers and steam turbines and has a capacity of 500,000 lbs/hrs steam; the Trenton ICES uses a 12 megawatt, medium speed dual fuel diesel engine and the Clark ICES utilizes one 1.5MW dual fuel diesel engine. The communities served vary considerably in size.

Through these demonstrations it can be shown that the Grid-ICES concept is beneficial under a variety of settings, a variety of cogeneration technologies, a variety of sites and configurations and a variety of electric exchange arrangements between the cogenerator and the local utility.

The objective of the demonstration of the Georgetown University ICES is to show how a small urban subcommunity can utilize coal based cogeneration to the economic, energy and environmental benefit of the subcommunity and possibly the surrounding community as well. A fluidized bed boiler of 100,000 lbs/hr capacity is producing medium pressure steam and a topping turbine will produce byproduct electricity. The fluidized bed will work with conventional gas/oil boilers as back-up and a large solar/electric facility will augment the electrical production of the steam turbine. High sulfur coal is utilized in this installation without adverse environmental effects.

The Mine Water Heat Pump ICES at Scranton, PA. is attempting to utilize the constant temperature source of water of underground coal mines to provide heating and cooling to a small subarea in Scranton, PA.. Large built-up water to water heat pumps will be utilized to upgrade the heat of the ground water to the temperature that is suitable for district heating during the winter and to lower the underground water temperature during the summer for district cooling. At this stage the environmental, legal, regulatory and other institutional evaluations are underway. Test wells have been drilled and detailed engineering design will be initiated shortly.

The large scale demonstration activity was initiated in FY 1979. The objective of this effort was to determine whether and under what circumstances the retrofit of an existing electrical plant for cogeneration and the installation of a distribution piping network was feasible. Our early analyses showed that such installations should be feasible for a radius of to 10 miles from a central business district having a minimum density of 1,000 people per square mile and experiencing electrical costs above .04/KWH. The proposed electrical plant for retrofit had to be base or intermediate loaded in order to ensure adequate hours of operation and projected years of further operation. Selected were two States (Minnesota and Wisconsin), two large metropolitan areas (Philadelphia and Detroit), one region (the northeast New Jersey region served by PSE&G Company), one medium sized city (Toledo, Ohio) and two small cities (Piqua, Ohio and Dover, Ohio). At the same time, the Minneapolis/St. Paul area was investigated as a potential application of large district heating from nuclear power plants. After the preliminary feasibility analysis, Philadelphia, Dover, Toledo and the State of Wisconsin dropped out of the program. In the State of Minnesota, the cities of St. Paul, Moorhead and Redwing continued their efforts towards implementation. Detroit, Piqua and the

PSE&G region including Newark and Jersey City are also continuing their efforts. It is noteworthy that the results of all the cases that were analysed for feasibility were positive and reaffirming the findings of the generic assessment work that was performed in the previous years by DOE. Currently, all of these projects have dedicated teams working intensively to resolve the large variety of legal, regulatory, financing, ownership and operational problems associated with each project.

In addition to the above projects, about a year and a half ago, United Illuminating of Connecticut, as a result of our funded CCEMP activity in Bridgeport, CN., undertook a feasibility analysis for retrofitting their electric plant. The results of their analysis have been encouraging enough to propose a joint effort to continue their work towards engineering and preconstruction arrangements. DOE entered into a contract with UI for the feasibility and preliminary design. This project is now underway and the results should be available within the next year.

As mentioned, a competitive solicitation was issued by HUD and jointly funded by DOE and HUD to engage 25 to 30 communities in the assessment of district heating and cooling as a vehicle for economic revitalization and downtown redevelopment. Twenty-eight cities have been selected and negotiations are now underway for finalization of the agreements covering this work. DOE, in addition to the financial participation of \$750,000., in this procurement will provide up to 100 hours of technical assistance to each city. This technical assistance will take advantage of all the information, expertise and experience that has been gained through our generic work and our demonstration work during the last four years.

Current and Future Activities

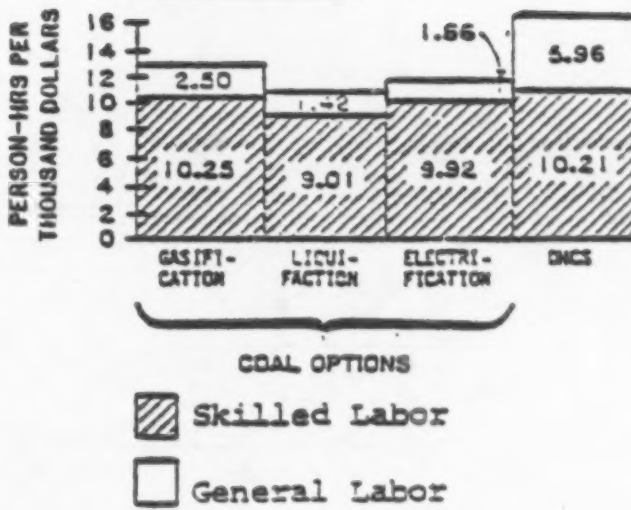
Recognizing the complex nature of the problem, an interagency activity, under the guidance and direction of DOE was initiated last year. The objectives of the activity were to bring together, in one document, all knowledge as to the benefits and costs of district heating and cooling as well as a determination of the barriers currently impeding wide scale implementation. Such a document, prepared with the input of many parties and view points would be a comprehensive document from which various possible Federal actions could be defined and against which they could be evaluated.

That work has been in progress for about a year. A preliminary draft became available to the Agencies participating in the effort in March. Based on a review by the Interagency Working Group, a new draft report has been prepared and is undergoing review at the working level.

This concludes our prepared statement. We will attempt to answer any questions the Committee may have at this time.

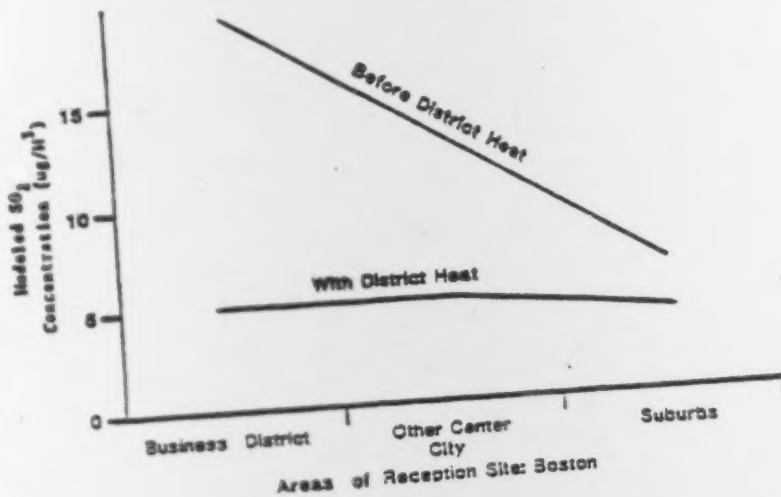
Thank you.

FIGURE ONE.



AN INDICATOR OF CONSTRUCTION JOBS CREATED FOR EACH DOLLAR OF INVESTMENT IN ENERGY SYSTEM CAPACITY

FIGURE TWO.
THE RELATIVE AIR QUALITY BENEFITS OF DISTRICT
HEATING ARE GREATEST DOWNTOWN



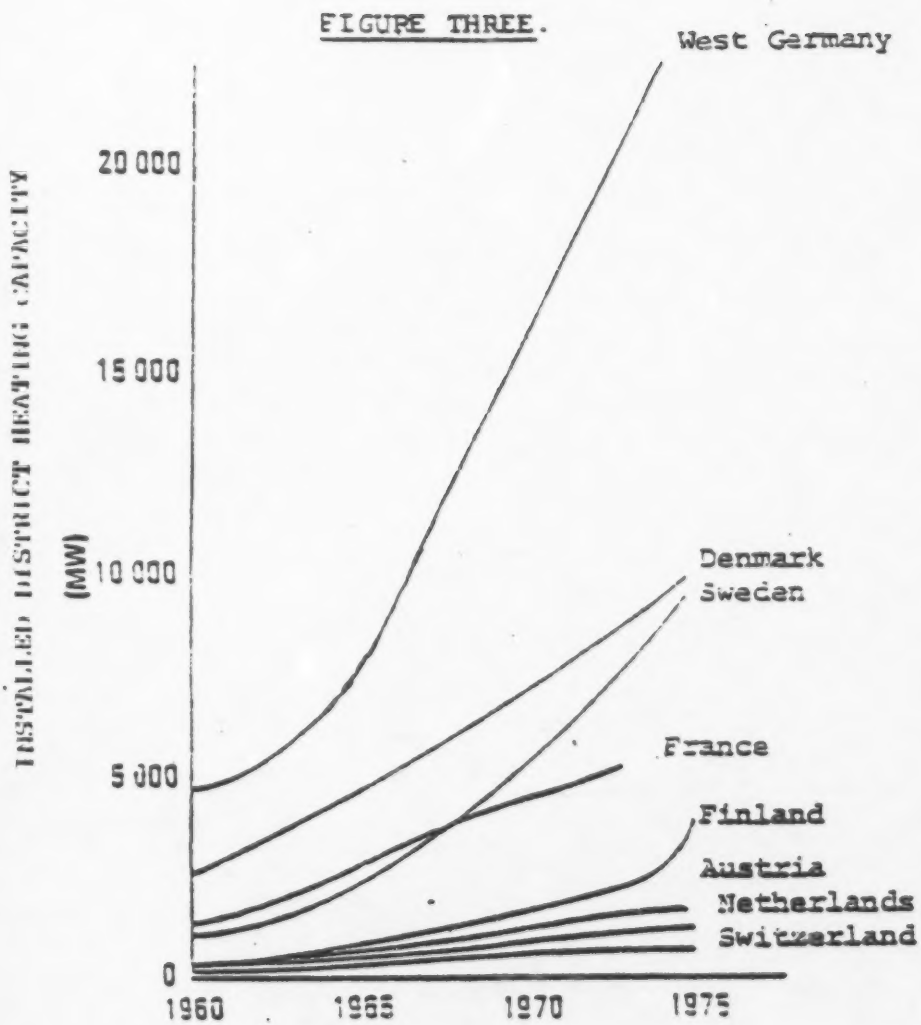


Table I
1979 GASOLINE PRICES

Country	Price/Gallon (Including Tax)	Fuel Tax/gallon	Value Added Tax*/gallon
France	2.62	1.67	--
U.K.	2.21	0.70	15%
W. Germany	2.19	0.81	12%

*Value added tax is included in the price, but is separate from fuel tax.

Source: 1979 International Energy Annual, (EIA, August 1980).

TABLE II
HUD/DOE DISTRICT HEATING PROJECTS

<u>City</u>	<u>Population</u>	<u>Service Area</u>	<u>Heat Sources</u>	<u>HUD/DOE Funds</u>
Albany, NY	116,000	Industrial Park, 3 Colleges and Rehab. Housing	Refuse and Cogeneration	38,840
Allentown, PA	102,000	Downtown	Refuse, waste Heat	50,000
Atlanta, GA	405,000	Central Business District	Cogeneration and Waste	64,200
Atlantic City NJ	42,000	Residential and Commercial	Refuse	48,000
Baltimore, MD	790,000	Midtown, South Baltimore and Canton	Refuse and Cogeneration	65,958
Bellows Falls, VT	10,000	Central Business District	Geothermal	58,100
Berlin, MD	40,000	Industry, Commercial	Geothermal	39,750
Cambridge, MA	98,000	Riverfront, Industrial District and Residential	Refuse, Waste Heat	50,000
Campbellsville, KY	7,500	Neighborhood Redevelopment	Underground Water	78,750
Columbus, OH	525,000	Low and Moderate Income housing and Industrial	Waste Heat, Cogeneration	99,376
Dayton, OH	190,000	Low and Moderate Income housing and industrial	Waste Heat, Cogeneration and Refuse	49,500
Devils Lake, ND	7,500	Downtown	Coal and Waste Heat	39,400
Ecorse, MI	14,500	New Development	Waste Heat, Refuse	50,000
Fort Wayne, IN	181,000	Neighborhood Redevelopment	Waste Heat, Cogeneration and Refuse	44,500
Galax, VA	6,700	Hospital, Commercial and Textile	Refuse	50,000
Gary, IN	156,000	Downtown	Waste Heat, Cogeneration Refuse	50,000
Holland, MI	22,000	Central Business District, University and Industry	Coal Cogeneration	40,500
Lawrence, MA	62,500	Downtown	Industrial Boilers and Cogeneration	58,500
Lewiston, ME	40,500	Industrial, Commercial and Downtown	Cogeneration and Refuse	58,000
Missoula, MT	33,000	Central Business District	Wood, Cogeneration and Refuse	49,000
New York, NY	7,000,000	Depressed neighborhood, Navy Yard and S. Bronx	Cogeneration and Refuse	75,000
Norwalk, CT	77,000	Downtown	Cogeneration	57,750
Provo, UT	74,000	Low and Moderate Income Housing, Central Business District	Cogeneration, Waste Heat and Refuse	50,000
Richmond, IN	44,000	Central Business Dist- rict, Industry and Rehabilitation	Waste Heat and Cogeneration	40,000
Santa Ana Pueblo, NM	1,000	Downtown	Refuse, Waste Heat and Geothermal	57,984
Springfield, MA	152,000	Central Business District, Industry	Cogeneration, Sewage Methane Refuse	65,000
Thermopolis, WY	10,000			50,600
Union County, NJ	24,000		Geothermal	35,000

Mr. VOLKMER. Before we do that, we have another vote at this time. We are going to recess again until about 5 minutes after 12:00. At that time Congressman Scheuer from New York will take the chair.

I wish to thank you for your testimony.

I would like to ask you one question. When can we anticipate that the policy paper will be concluded?

Mr. TRIBBLE. There is no time schedule that has been set at this time.

Mr. VOLKMER. Will it be September, October?

Mr. TRIBBLE. Certainly it would be, I would hope, in that time-frame.

Mr. VOLKMER. By that time frame. Thank you very much.

We will recess until 5 minutes after 12:00.

[Recess taken.]

Mr. SCHEUER [acting chairman]. The subcommittee session will continue. We will be going until about 25 minutes after 12:00 and then we will suspend.

I would call on Mr. Dodge to continue.

STATEMENT OF DONALD DODGE, DEPUTY ASSISTANT SECRETARY FOR COMMUNITY PLANNING AND DEVELOPMENT, U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

Mr. DODGE. Thank you, Mr. Chairman and members of the subcommittee.

I would like to thank the committee for providing an opportunity to discuss district heating and cooling and the activities that HUD and DOE are undertaking. Assistant Secretary Tribble has provided remarks on the research and development program DOE has pursued to provide so much of the technical information needed for decisions on district heating and cooling investments.

As mentioned, we have jointly prepared an extensive statement we are submitting for the record. With the chairman's approval, I would like to summarize those aspects of our joint statement that explain why HUD shares DOE's interest in the potential of district heating and cooling to meet important national and local policy objectives for community and economic development, as well as for reducing the use of scarce fuel resources.

Mr. Tribble has touched on some of the barriers facing both the expansion of existing district heating and cooling systems and the building of new ones. As DOE carried out their earlier work on technical issues and reviewed existing systems, they recognized that technology was not the principal problem impeding widespread adoption of district heating. Smaller systems have been built steadily by universities and hospitals, as you heard earlier, and the military has been building systems of community scale.

Why not the private and commercial sector? The tough hurdles arise in institutional relationships existing in every community which control complex enterprises, in the network of regulations governing publicly and privately owned utilities, and in the complexities of financing an enterprise with huge investment requirements and several years of negative cash flow.

As DOE became aware of these problems, they came to HUD, saying in effect:

Your Department works with city governments and community groups. You work with financing and taxation and land use controls. You have worked with the entire gamut of issues that must be resolved in development projects. Why don't we pool our knowledge and see what it is going to take to get widespread acceptance and market penetration for district heating and cooling systems?

HUD examined the potential for these systems to have a significant impact on community and economic development and housing concerns for which the Congress has given HUD the responsibility. Our initial examinations show a major, longlasting potential for towns and cities. Over the next 10 years, preliminary estimates show a potential for nearly \$100 billion in cumulative investment in district heating and cooling systems in cities and towns. These estimates also show \$70 billion in cumulative fuel savings. They show between 600,000 and 700,000 man-years of employment, steady employment in cities where jobs like these for less skilled labor are in short supply.

To put these numbers in perspective, let me remind the committee that the United States is currently using 78 quads of energy each year. A quad is the amount of energy used in running 5 million cars or heating and cooling 7 million homes for 1 year. If the quad of energy is produced with imported oil, it currently costs the country \$7 billion in our balance of trade.

The efficiencies of district heating and cooling can reduce our energy consumption by the end of the century by 5 to 7 quads. If all of the energy came from imported oil, at current prices the United States would have roughly \$50 billion per year that could go into productive investments in this country rather than going abroad. Conservatively, if even a third of these potential new district heating and cooling systems displace imported oil, more than \$10 billion per year could be going into productive investment in this country by the end of this century rather than going abroad.

Beyond the direct investment and employment effects, there are other benefits. First, there is the usual multiplier for secondary jobs generated by primary employment. Second, there are impacts on business location decisions flowing from reduced rates of increase in energy costs. Business is constantly faced with decisions on making existing facilities more energy efficient when considering expansion or relocation to more efficient facilities. Energy is not the only consideration in a relocation decision but it has taken on an importance no one would have expected 10 years ago.

District heating and cooling systems can stabilize business energy costs. They substitute capital for fuel, making district heating and cooling systems much less sensitive to arbitrary fuel price increases. They also make it possible to plug additional heat sources using different fuels into the distribution network. In a larger system designed with fuel flexibility in mind, coal or gas boilers, oil-fired cogenerators, industrial waste heat sources, municipal incinerators, and geothermal wells could all feed hot water to the same distribution loop.

The point is that in many distressed cities and towns where every job counts, the installation of district heating and cooling systems provides an attractive magnet to business and industry. Obviously, that is a critical concern to places that are most dependent on community development block grants, urban development

action grants, and various housing assistance programs to keep their revitalization efforts alive.

We see district heating and cooling as a potentially important tool in the process of revitalization. It is a tool that requires collaboration between local governments, State government, and the private sector. We can appreciate the complexities and need for close cooperation in getting such systems in the ground, if we think of what would be required to install the electric systems we all take for granted. If we had to start with all of the physical plant and institutional arrangements we now have in place, knowing the potential importance of electric distribution systems to our economy and to our way of life, Americans would plow through the obstacles and build the systems.

The potential and the challenges presented by district heating and cooling systems are nearly as great but with careful planning and public/private collaboration we can build these systems incrementally. It is a question of how much it is in the national interest to move more quickly.

We have taken steps with DOE to start a series of actions which will make possible practical appraisals of real, not theoretical, installations. As Mr. Tribble indicated, we have 28 cities and towns under contract to assess the feasibility of every type and size of district heating and cooling system that might work in their specific circumstances.

We have required that each city establish an advisory working group on which interests critical to the ultimate success of a district heating and cooling project are represented. That usually means, in addition to top city officials, representatives of banking, utilities, commercial and industrial firms, and potentially affected neighborhoods.

We will decide in the next several months whether we can provide further assistance in carrying the results of these initial assessments through to the detailed design and cost analysis of the single system which each city finds most beneficial. We believe that the efforts we are sponsoring now will enable several projects to obtain private financing.

This concludes my summarizing remarks and I am available for questioning.

Mr. SCHEUER. Mr. Tribble, a couple of questions to you: What exactly are DOE's plans for district heating and cooling for fiscal year 1982? What activities will be carried out of funds that were appropriated by Congress?

As you know, the committee authorized \$1.5 million for this program for fiscal 1982, and the House Appropriations Committee appropriated \$2 million but earmarked it toward specific projects which were not, strictly speaking, necessarily district heating.

What do you plan to do for 1982?

Mr. TRIBBLE. We are going to use whatever money is available to phase out the activities that we are now in, and then if additional money beyond that requirement is provided, we would intend to look into the feasibility of rehabilitating existing district heating systems.

Any additional funds would be used to analyze and document the information that we have obtained from the work that we have in progress.

Mr. SCHEUER. What are DOE's plans for 1983 and beyond?

Mr. TRIBBLE. We, of course, do not have any plans beyond 1983 but we would be amenable to whatever the Congress comes forth with.

Mr. SCHEUER. Now if Congress appropriates more than the administration request for 1982 in the field of energy conservation, will DOE request a rescission, a rescission of these additional funds?

Mr. TRIBBLE. Congressman, I would expect that that would have to be looked at in the overall context of the amount of money, and I am really not in a position to answer yes or no on that at this time.

Mr. SCHEUER. Would DOE request a rescission of the fiscal year 1981 deferrals?

Mr. TRIBBLE. I think that would have to fall into the same category.

Mr. SCHEUER. All right.

Now a couple of questions on your statement, which reflects great enthusiasm for district heating and outlines many of its benefits, yet you propose no Federal funding at all for district heating activities past fiscal 1981. Is that correct?

Mr. TRIBBLE. That is right.

Mr. SCHEUER. Well, how can you reconcile that with the vast amount of testimony we have received this morning about the financial, economic, regulatory, and also technical problems that face this technology, that are going to require some intensive Government efforts before we can cope with the new technology and take advantage of its potential?

Mr. TRIBBLE. We feel that the technology is well established. The principal problem is economic justification. The studies that have been made, and some of the testimony that we have heard here this morning has demonstrated that current high interest rates and other issues such as determining in advance how many customers would be committed and what their long-term needs would be, are things that we see as the impediments to the furtherance of the district heating system.

While in some instances—particularly in the frost belt—they will compete better with No. 2 oil, there are other sources of energy where the competition is much more difficult. The economics of each individual situation would have to be judged very carefully.

Mr. SCHEUER. Now on page 4 of your short statement, you state as your justification for not funding the second phase of DOE/HUD cooperative agreements—that is, the engineering and preconstruction studies—that "It is a policy of this administration not to participate in demonstration programs where the technology is well known."

Now it is our understanding that the purpose of these agreements was not to demonstrate a technology but rather to help communities put together a team and a plan to seek private sector funding for their projects, and the Federal seed money under this kind of an approach would then simply be employed to leverage

private investment. Do you feel that this is a proper role or an improper role?

Mr. TRIBBLE. We think that under the present circumstances the Federal Government should not be involved in this. The economic considerations are better addressed by the local municipality and the entities that would be involved.

Mr. SCHEUER. Well, you see, we have not come quite to the point where we are taking full advantage of the benefits of the technology. We are in a desperate race with time to free ourselves from bondage on foreign oil supplies, shaky and unstable and unreliable as they are. We must rid ourselves from reliance on Persian Gulf oil. I think there is a national consensus on that.

There is beginning to appear some technology that can reduce that dependency and make substantial economies in our energy use. I frankly am at a loss to understand why a very modest amount of Federal seed money investment there would not be highly appropriate.

Mr. TRIBBLE. Other things are being done, of course, that will help us free ourselves from dependency—

Mr. SCHEUER. Yes, but this is a technology that is almost waiting there to be used, and this is a little seed money to help communities staff up their team, carry out their feasibility analyses and plan to seek private sector funding. What we are providing is a little oil to grease the machinery.

Does it overly challenge the imagination to see that there is sort of a supportive Federal role there for a brief period of time, while communities get their act together and learn how to cope with this technology and how to get the benefit of private sector funding?

Mr. TRIBBLE. This is certainly a question that deserves a good bit of consideration.

Mr. SCHEUER. Well, that is what we are here for.

Mr. TRIBBLE. One other factor, I think, is that any moneys that we would have to allocate for this would have to be borrowed by the Federal Government at a substantial rate of interest. The experience that we have determined from the investigations, is that these district heating and cooling programs are very site-specific, and that the local entities are in the best position to judge whether or not they would be viable for that particular location.

Mr. SCHEUER. Well, local entities apparently want to apply this technology, and local municipalities and cities apparently want to get private funding but they need a little assistance in putting their package together and getting the right technological inputs. Can't you see a very modest supportive Government role there?

Mr. TRIBBLE. We have information that we have gathered through the years and we certainly want to make it available to them. We want to put them in touch with the people who do have the answers. We do not feel that financing this kind of operation under current economic circumstances is an appropriate role for the Federal Government.

Mr. SCHEUER. Well, now, let's just go to a specific. As part of its district heating program, DOE has put together teams of experts at the Oak Ridge National Laboratory and the Argonne National Laboratory which are uniquely qualified to provide technical assist-

ance to these communities that we have talked about that wish to implement this technology.

Does DOE plan to make any provision to keep these teams together and to continue to make their technical assistance available to communities in fiscal year 1982 and beyond?

Mr. TRIBBLE. This is one of the things that we would do in the event that money was available in fiscal year 1982.

Mr. SCHEUER. You know you are not talking about very much money. According to our information, it costs less than \$500,000 a year and would be of great assistance to communities who are seeking to implement district heating. Now this is an infinitesimal sum.

Mr. TRIBBLE. Yes, it is.

Mr. SCHEUER. Do you have any problem keeping these teams together?

Mr. TRIBBLE. I believe that these teams are groups of people in these national labs who have this expertise along with other expertise, and they would not necessarily be disbanded if this financing was not provided. They would still be there. They would be working on other projects, and if a city or such did in fact want this expertise, then they possibly could be made available.

Mr. SCHEUER. Who are they going to charge their time to, these experts, when the time comes that some municipalities or cities need help? They have to charge their time to some worthy purpose. Who is going to pick up the tab if a city wants help?

Mr. TRIBBLE. It would be possible for the joint group that was interested in the project to pick up that tab.

Mr. SCHEUER. What joint group? The city wants help in preparing a feasibility analysis or a sophisticated presentation to a banking group in the private sector. Who is going to pick up the tab?

Mr. TRIBBLE. The municipality, and presumably the municipality would have some additional participation at that point.

Mr. SCHEUER. Participation from whom?

Mr. TRIBBLE. Perhaps the utility company.

Mr. SCHEUER. The utility has not made any commitments. The city is trying to get the utility to come in. This is for feasibility analysis, and preparation of charts and engineering surveys and studies and so forth. This is to get the utility hooked. Before they are hooked, they are not putting their money in. I am asking you: Where is this seed money coming from?

Mr. TRIBBLE. I would think it would have to come from the municipalities, sir.

Mr. SCHEUER. You are not ready to commit one-half a million bucks to this?

Mr. TRIBBLE. I am afraid under the circumstances I would have to answer no.

Mr. SCHEUER. OK.

A couple of questions for you, Mr. Dodge: In April of 1980, former HUD Secretary Robert Embry wrote former DOE Deputy Secretary John Sawhill—from my city—a letter expressing HUD's strong support for an expanded national district heating program. He stated: "We at HUD are now persuaded that over the next 20 years modern forms of district heating can bring many U.S. cities

major social, economic, environmental, and energy benefits, and that implementation on a broad scale should begin now."

Does that letter, and specifically the quote that I just read, represent current HUD policy toward district heating?

Mr. DODGE. Mr. Chairman, that does not represent current HUD policy. The expansion upon HUD's efforts in the demonstration, is not contemplated now. We believe that the results of that feasibility demonstration will be sufficient that they can be shared with cities nationwide, and we believe that for now that will be a sufficient involvement of HUD.

In addition to that particular effort, HUD has been involved in other efforts, not promoting district heating per se but, as Mayor Holland mentioned this morning, we are involved in promoting their project, helping them carry out their project with some financing with action grant moneys. If such projects do come to our attention in the future, and if the financial package is properly prepared, we would most likely be sympathetic to such a project.

What was discussed at great length this morning was financing mechanisms, basically tax credits, that are being considered by the Congress at this point. One I would like to add to that, and add to it in terms of a financing technique, is, tax increment financing which is used extensively in some States, not in others. However, it is a device, a tool that would help States and localities to carry out programs they design.

Mr. SCHEUER. I would ask unanimous consent that this letter that I just referred to be placed in the record.

[Material to be supplied follows:]



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, D.C. 20410

OFFICE OF THE ASSISTANT SECRETARY
FOR COMMUNITY PLANNING AND DEVELOPMENT

APR 29 1980

IN REPLY REFER TO:

Dr. John Sawhill
Deputy Secretary
Department of Energy
1000 Independence Avenue, S.W.
Room 7B152
Washington, D. C. 20585

RE: District Heating

Dear John:

We are now persuaded at HUD that over the next twenty years modern forms of district heating can bring many U.S. cities major social, economic, environmental, and energy benefits and that implementation on a broad scale should begin now.

Although district heating appears to have potential for almost three quarters of the country and, in the form of district cooling or industrial process heat, may well make sense for the rest, it seems particularly feasible and beneficial for some of our most distressed areas: the large, industrial, densely settled, pollution plagued, and oil dependent communities of the East and Midwest. Moreover, from a national energy policy perspective, district heating is a way, and perhaps the only practical way, of converting the heating systems of vast numbers of urban based buildings to coal without severe environmental and social disruption.

I plan to attend the presentation at your office on May 3 but felt it would expedite matters if you knew our thinking in advance. I would first like to summarize the advantages of district heating as we understand them; second, review some of the major impediments we see to implementation; finally, give you our proposed action agenda.

We think the facts and informed opinion will support the following:

1. Modern district heating is used widely in Europe, the Soviet Union, and recently, Japan. As yet, there is no major urban hot water district heating system in this country.

District heating is now used by about a third of the Swedish and Danish populations, serves 70% of Soviet urban heat demand, and is supplied in West Germany through some 474 central heating networks.

It's rate of installation abroad is accelerating, particularly in those countries most dependent on imported oil. In this country, by contrast, less than 1% of thermal demand is supplied by district heat, and that primarily by old steam systems, built early in the century which are now marginally economic and often in disrepair.

The foreign grids were installed in large part after World War II, and rely upon waste heat from electric power generation, industrial processes, and trash incineration. Often hot water rather than steam is the thermal medium, which is cheaper, permits higher co-generation efficiencies, and greater geographic reach (50-60 miles for hot water; up to 5 miles for steam).

2. District heating, if implemented in the U.S. now, could save one to 2.5 million barrels of oil or natural gas equivalent a day by the year 2000.

The major effect of district heating is to displace the oil or natural gas burned in individual building boilers by waste heat from electric power plants, industrial processes, trash incineration, or other heat sources, such as geothermal. Power plants can, and in the future increasingly will, burn coal or uranium. Even where they burn oil or natural gas, in the co-generation mode their fuel efficiencies will be far greater than individual building boilers. The DOE estimate above is based on the installation of district heating in 300 cities where thermal demand is sufficiently dense and power plants sufficiently close to make the systems economic.

Some rough idea of the cost effectiveness of district heating from a Federal perspective, can be learned from the St. Paul, Minnesota project now in the advanced planning stages and due to start construction in 1981. This system, which will ultimately provide 2600 megawatts to a large portion of Minneapolis and St. Paul, will take 20 years to build completely and cost about \$750 million in 1980 dollars. Over the 20-year build out period, it is estimated the project will displace about 50 million barrels of oil or equivalent, and thereafter, about 5 million barrels per year. The direct Federal investment, including feasibility studies and probable DOE and HUD grants to get the project started, should not exceed \$20 million. Thus, it will cost the Federal government about 40¢ for every barrel of oil or equivalent displaced during the first 20 years.*

* The feasibility of the project turns on tax-exempt financing. It can be argued there is a further investment in terms of lost tax revenues, which a sophisticated analysis should perhaps include. It is difficult to know how much this loss would be, however, because the project will be built in stages and after the early years of negative cash flows might be capitalized out of retained earnings.

About \$300 to \$400 million over the next three years would probably be ample to stimulate wide-scale implementation, particularly if the tax and regulatory disincentives described below were removed. Like St. Paul, most systems will need only a front-end stimulus to get the feasibility work done and first phase construction started; thereafter, the projects will be self-financing.

3. District heating can provide dramatic improvements in air quality.

Another effect of district heating is to replace small, ground level but uncontrolled sources of air pollution by a controlled central source. Although there is some increase in emissions where a plant co-generates, nevertheless, the net effect, particularly where the market area is predominately oil burning, is a dramatic reduction in ambient concentrations. For example, Stockholm, which uses mostly oil for building boilers, had concentrations of SO₂ of 200 micrograms per cubic meter, annual average, in 1960 when it began its system; in 1980 these emissions have been reduced to around 120 micrograms; by the year 2000, when the system is fully built out, it is estimated SO₂ will be at about 40 micrograms per cubic meter, a five-fold reduction and half that of the current U.S. health standard of 80 ug/m³. In St. Paul, Minnesota, where 70% of the buildings use natural gas, studies by Oak Ridge National Laboratory show that annual average ambient concentrations of SO₂ would be about 40 micrograms per cubic meter without district heating and about half that with the system in place.

4. District heating systems will pay for themselves.

The economics of any district heating project are very site specific. In general, however, it appears that for many, many communities these systems can cover annual operating and maintenance expenses and pay back capital investment well before the end of the life of the project assets. The feasibility study by Oak Ridge for St. Paul shows that using tax-exempt financing there is a significant net accumulated value over 20 years; the Detroit project, which is somewhat more limited in scope, preliminarily appears sufficiently attractive to be financed by Detroit Edison.

5. Only district heating can give cities full access to alternative and renewable energy sources.

District heating infrastructure are probably essential to convert buildings in densely settled areas to the full use of coal. In addition, a thermal grid can provide an energy market for municipal solid waste, which will be increasingly important as cities run out of landfill. Cities should probably start to plant and build

now the piping systems that will give future access to sources of renewable energy, which are being developed, like geothermal and solar thermal. Solar advocates seem to agree that in high density areas some sort of piping and community heat storage systems will be required for full solarization. In Stockholm, which will be totally on district heat by the year 2000, a suburban community is already building a district heating grid which will rely exclusively on solar energy.

6. District heating can make cities more competitive and help retain and expand their tax and employment base.

Officials in St. Paul estimate their systems will provide heat at about 50% the cost of oil and 75% the cost of natural gas. Detroit Edison is an active participant in a Detroit project, primarily as we understand it, because the utility now believes that maintaining and expanding the industrial base of the city requires the offering of thermal energy competitive with natural gas.

7. District heating will help stabilize heating costs for low-income, multi-family housing.

Low-income, multi-family buildings, including public housing and HUD assisted housing, tend to be located within close proximity to the high heat demand areas which would form the core of a district heating system. Large fuel subsidies are being paid by the Federal government to tenants in many of these structures. Moreover, the rate of building abandonment due to fuel costs has increased steadily in this segment of the housing stock. District heat could relieve what will be an increasingly difficult and expensive problem for government in future years.

8. District heating will require cooperative efforts between cities, utilities, industry, building owners, and others which will help cities in energy planning and management.

Most local governments today are almost totally unequipped to analyze energy use and make decisions about how to reduce demand and develop new sources. Planning and building district heating systems will require close cooperation between local governments and professional energy managers like utilities and heavy industry and will be a powerful stimulus toward a sophisticated understanding of community energy use and supply. Cities themselves should thereby be able to better understand the energy needs of its private constituents and more intelligently use the power of local government for long range energy ends.

9. District heating projects will create jobs for unskilled, low-income, and minorities in urban areas.

A district heating project for a large city could easily be a billion dollar project, last for 20 years, and generate many low-skill and minority employment opportunities.

A Bureau of Labor Statistics model shows that this kind of public works project generates about 70 direct jobs for every million dollars invested. We do not have an accurate estimate at present for indirect jobs generated in areas like piping manufacture and heat exchanger installation and repair, but in effect whole new industries would be created which at a bare minimum would create employment equal to the direct jobs produced. Thus, a typical medium to large city project, assuming an even outlay of \$50 million a year over 20 years, would generate 3,500 direct jobs and the same number of indirect jobs, although unquestionably the latter would tend to grow cumulatively over the 20-year period.

A study by Argonne National Laboratory, which contrasts the employment effect of district heating with synfuel projects, shows that district heating projects will be almost twice as labor intensive and far more effective because of likely location in distressed urban areas in reducing minority unemployment, youth unemployment, and poverty in poor neighborhoods.

Turning to the question of why district heating isn't moving at a faster rate, there appear to be a number of interrelated factors, chief among which are the following:

1. Most electric utilities are negative.

A consultant for EPRI, Ed Doyle, has just completed a survey of utility executive attitudes on district heating and has found that most are negative. Executives of companies with existing steam systems, which are often marginal and which many would like to abandon, tend to be particularly negative. Although attitudes are mixed, many electric utility executives feel they have enough problems today without taking on a new and uncertain market.

On the other hand, there are a number of utilities that are actively exploring or implementing projects: Northern States Power in two cities in Minnesota; Detroit Edison in Detroit, Michigan; United Illuminating in Bridgeport, Connecticut; Pepco in Washington, D.C.; Public Service Electric and Gas in Northern New Jersey; Philadelphia Electric Company in Philadelphia; and many municipal utilities in smaller communities.

2. Federal policy at present does not support district heating.

For example:

- (a) Neither tax-exempt revenue bond financing above the small issue IDB limit nor investment tax credits are available for district heating distribution systems under current law.

A high percentage of the capital cost (70%-80%) lies in the transmission and distribution piping, which at present does not qualify for either tax-exempt revenue bond financing above the \$10 million dollar small issue limit or investment tax credits. An amendment to the windfall profits tax, which would have provided unrestricted tax-exempt financing for district heating piping, was eliminated in the conference committee. This is a serious impediment because many cities, particularly distressed cities, often cannot and probably should not use general obligation tax-exempt bonding for these systems. Although projects can be built using utility financing, they will necessarily be more restricted in scope, concentrating on areas of high demand and utilization, and the community will not receive the maximum benefit.

- (b) The applicability of the EPA "bubble policy" to co-generation/district heating is not clear.

Utilities would have considerably greater incentive to get involved if credit for reduced building emissions could be applied against increased power plant emissions. For example, Pepco, in a letter to EPA dated March 18, 1980, proposed to retrofit its coal-fired Potomac River Generating Station with thermal extraction equipment and supply steam to the GSA district heating system, thereby minimizing use of oil-fired heat only boilers and reducing particulate emissions. Pepco asks that the bubble policy be applied to permit it to switch the Benning plant from #4 to #6 fuel oil, which would save the utility about \$3 million a year and still leave a net reduction in particulate matter. EPA has not, to our knowledge, ruled on this matter. An important issue here is whether EPA will permit an offset for reductions in uncontrolled, and thus uncounted, building emission sources.

- (c) EPA policy does not encourage co-generation/district heating.

There are a number of incentives which could be included in the final FUA regulations, which we understand are still being drafted. For example, in the co-generation exemptions, applicants that are supporting district heating projects could be given

priority. In the fuel allocation area, incentives could be given to community co-generation systems by providing priorities in the allocation of natural gas.

- (d) FERC policy does not encourage co-generation district heating.

FERC could influence utility participation by working with state public service commissions to allow fuel adjustment clause pass throughs only to utilities which are making efforts to conserve scarce fuel by implementing district heating systems, where feasible and cost effective. It could permit cost of work in progress (CWIP) to be included in a utility's rate base for co-generation equipment and district heating facilities.

3. District heating feasibility studies are expensive, time consuming, and made more difficult by current legal, regulatory, and financing uncertainties.

An initial assessment - just to see if its worth doing a detailed study - might cost \$50,000 for a large city. A detailed study, up to preliminary engineering, might cost \$500,000. At present, studies are made more expensive and complex by the lack of legal certainty, and lack of financial and regulatory incentives. In addition, planning and implementing a project requires bringing together a multi-party group which in itself is expensive and time consuming.

A task force chaired by Alan Rubin of DOE has prepared a National District Heating Program Strategy, which we endorse. At the same time, I would hope we could join now in some concerted actions to get things going immediately. Some steps which have occurred to us are the following:

1. Form a subcommittee of the Interagency Coordinating Committee chaired by DOE to focus on the environmental, tax, and regulatory issues mentioned. It seems to me a White House supported policy implementation group would be useful.

2. Sponsor a program, funded equally by HUD and DOE, to provide cost sharing to about 50 communities which can bring forth the necessary private/public teams to investigate feasibility and begin the arrangements for project implementation.

It also occurs to us that a district heating component added to the pending utility oil backout program might help alleviate some environmental concerns over coal conversion, and, in light of the

economic and social benefits of district heating, also broaden the base of political support for the bill.

I look forward to discussing these ideas with you on May 3.

Sincerely,


Robert C. Embry, Jr.
Assistant Secretary

cc: Secretary Moon Landrieu, HUD
Under Secretary Victor Marrero, HUD
Deputy Under Secretary C. Worthington Bateman, DOE
Assistant Secretary Thomas E. Stelson, DOE
Assistant Secretary George W. Cunningham, DOE
Hazel R. Rollins, DOE
John Milhorne, DOE
Neal Goldenberg, DOE
Barbara Blum, EPA

Mr. SCHEUER. Mr. Dodge, do you agree with Congressman Oberstar of Minnesota that the Federal Government should provide assistance to cities and towns to carry out feasibility studies and engineering and design studies for district heating systems? Can such support be provided through existing HUD programs such as the UDAG block grants?

Mr. DODGE. Well, obviously the Department has had some interest in assisting cities. The number I suppose is at issue, how many cities should HUD help. The fact is, cities are able to carry out such feasibility studies on their own with the use of block grant moneys. That could be as many as 600 or 700 large communities and another 100 urban counties, as well as approximately 2,000 small cities per year. They have the option now to use those funds for that purpose.

Mr. SCHEUER. Are they doing it?

Mr. DODGE. Offhand, I know of no city that is doing that at this point.

Mr. SCHEUER. Is it known that they can use those funds? Have you gotten the word out there?

Mr. DODGE. We have not specifically sent that word out, although it is an obvious eligible cost. However, we have not promoted that.

Mr. SCHEUER. What happens when a tree falls down in the middle of a forest? Is there a noise where there is nobody there to hear? If you do not send the signal, how do you expect them to get it?

Mr. DODGE. Well, because of the very philosophical underpinning of the block grant program, we have not promoted special purpose programs. That is a choice to be made by the locality.

Mr. SCHEUER. It is a choice but if they do not know the choice is available, it is really a nonchoice. I mean, you are putting them in the dilemma where they have to hire a Philadelphia lawyer to know precisely, exactly what narrowly drawn, expertly phrased question to ask you before you will give them a responsive answer.

Why don't you tell them it is available? Why don't they know that that is one of their choices?

Mr. DODGE. Because, Mr. Chairman, that is a signal, a signal to our cities that it would be something which we are promoting. We are not promoting it. If we promoted that kind of program, we would be doing it at the expense of other programs. We believe that is a local choice and we want to leave it to the localities to make that decision.

Mr. SCHEUER. Are any of the 28 cities who received funding for preliminary feasibility studies likely to be able to construct district heating systems without some kind of subsidized financing for the construction? Will subsidized financing inevitably be required if such systems are to go forward? Will they be able to fund them in the private sector when it comes time for construction, in your view?

Mr. DODGE. In my view, it is precisely for that reason that the feasibility study was initiated, that is to determine if in fact they can find a source for the district heating technique that they want to apply in their community, plus the financial arrangements. My point would be that they already have tax credits available to them. They have tax increment financing in many places. They have industrial revenue bonds that I do not believe were mentioned, either, this morning.

They have that opportunity right now, and the communities involved in the feasibility studies are all of them receiving block grant moneys. Block grant moneys could very well provide that assistance, that gap financing, if it is not provided by the locality or provided by the private sector.

Mr. SCHEUER. All right. You have all been very patient and very helpful, and this has been a very useful and constructive hearing, which is now adjourned at the call of the Chair.

[Whereupon, at 12:30 p.m., the subcommittee recessed, to reconvene at the call of the Chair.]

[Additional material submitted for the record follows:]

Comments of the
AMERICAN PUBLIC POWER ASSOCIATION
on
DISTRICT HEATING AND COOLING
Submitted to the
HOUSE SCIENCE AND TECHNOLOGY COMMITTEE
ENERGY DEVELOPMENT AND APPLICATIONS SUBCOMMITTEE

August 10, 1981

The American Public Power Association submits the following comments on District Heating and Cooling, the subject of a Science and Technology Committee hearing on July 23, 1981. APPA is the national trade association of 1,700 publicly owned electric utilities in 48 states, Puerto Rico, the Virgin Islands, Guam, and American Samoa.

Publicly owned electric systems provide electric service to 13 percent of the nation's population and generate nine percent of the electric power produced in the United States. Also, approximately 30 U.S. communities are served by district heating and/or cooling systems owned and operated by their municipal utility. Of these, the majority (about 75 percent) are steam distribution networks; the others are either based on hot water or are hybrid systems (i.e., steam and hot water). Coal is the predominant fuel, though municipal solid waste and wood waste are being used in a few cases.

APPA and its membership are strong supporters of district heating and cooling because of its many attractive attributes: high efficiency in the cogeneration mode, environmental benefits, urban revitalization—including expanded job opportunities and tax base, fuel flexibility, stable energy costs, and displacement of oil and gas for space heating applications. Public power's advocacy of district heating was established in the Resolution approved at the 1980 Annual Conference of the American Public Power Association (Attachment 1). The APPA "Fact Sheet" (Attachment 2) provides additional details on the advan-

tages of district heating and cooling and calls for a sustained federal effort in this area.

APPA finds that \$10 million in fiscal year 1982 would be the appropriate level of funding for the Departments of Energy and Housing and Urban Development to further respond to the enthusiasm expressed during their solicitation for preliminary feasibility studies. More than one hundred applications for the grants were submitted; only 28 were awarded. Maintaining the continuity and pace of this program through FY82 would require \$8 million for DOE's Office of Building and Community Systems and \$2 million for technical assistance under the discretionary funds provided the HUD Assistant Secretary for Community Planning and Development.

The Interagency District Heating Coordinating Group has done an excellent job of identifying district heating and cooling opportunities in the U.S. and stimulating municipal interest in the technology. APPA supports the inter-agency approach to the extent that it retains its present cooperative spirit and effectiveness.

An enhanced federal role is essential to the near-term success of district heating and cooling. Assistance for the initial studies is helpful, but financial aid during construction appears to be vital. (Piping network costs are generally prohibitively high, representing unacceptable cash-flow problems in the early years.) A stable government role in research, development, a successful demonstration, information collection and dissemination, and consistent tax and regulatory considerations is critically needed. These are the points addressed in the legislation (H.R. 3204 and H.R. 3205) introduced by Representative Oberstar.

APPA member support for the Oberstar bills, to provide (H.R. 3205) for an accelerated program of assistance to small- or medium-size municipalities for

research and development and other assistance respecting district heating and cooling systems and to create (H.R. 3204) a residential energy tax credit and business investment tax credit for investments in certain property which will enable the taxpayer to use hot or cold water or steam provided by a district heating or cooling system, is set forth in the Resolution (Attachment 3) approved at the APPA 1981 Annual Conference.

Thermodynamically speaking, district heating and cooling could expand nearly a hundred-fold to good advantage, but significant further development is unlikely absent a concerted federal, state, and local government effort extending institutional (regarding fuel policy, tax status, utility definition, zoning provisions, etc.) as well as material support.

Some have proposed that district heating and cooling systems might be financed through the issuance of tax-exempt industrial development bonds. We do not believe this is appropriate public policy to be pursued. APPA and its members are becoming increasingly alarmed over the expanded use of tax-exempt bonds. We strongly feel that it is inappropriate to use tax-exempt bonds for other than legitimate governmental purposes. (We recently opposed the tax-exempt "All Savers Certificates" created under the recently enacted Economic Recovery Tax Act of 1981, for this reason.) Further, because there is a finite number of dollars and investors for tax-exempt issues, continued expansion of their use will force interest rates even higher to attract additional investment. Federal budget cutting tends to aggravate this problem, since it drives state and local governments to issue tax-exempt bonds for projects that otherwise might have been funded through a federal program.

Submitted by: Dr. R. Eric Leber
Director of Energy Research
American Public Power Association
2600 Virginia Avenue, N.W.
Washington, D.C. 20037
202/342-7226

ATTACHMENT 1

DISTRICT HEATING

WHEREAS, district heating is a system of supplying hot water or steam from a central source for distribution through pipes to commercial and residential consumers for heating and cooling needs, and

WHEREAS, district heating uses fuels more efficiently than individual burners and boilers and can constitute part of a cogeneration system, and

WHEREAS, district heating is environmentally sound because of the efficient combustion of fuel and because emissions from a central source can be controlled more easily, and

WHEREAS, district heating can use alternative fuels such as biomass and solid waste, and

WHEREAS, existing district heating systems in the United States are being retired because of a lack of funds to refurbish them, and

WHEREAS, new district heating systems in the United States can and should play a major role in solving the energy crisis;

NOW, THEREFORE, BE IT RESOLVED: that the American Public Power Association supports a Federal program to provide study grants to municipalities for testing the feasibility of municipal district heating systems and a revolving fund of low-interest loans to municipalities for the construction and refurbishment of municipal district heating systems.

—Resolution approved by the American Public Power Association at their Annual Conference in Washington, D.C., May 6, 1980

American Public Power Association

Fact Sheet

FY82 Budget for District Heating and Cooling

WHAT WE ARE REQUESTING:

The American Public Power Association represents approximately 1,700 local publicly owned power systems throughout the nation. APPA is requesting the Appropriations Committee to designate \$10 million for the Departments of Energy and Housing and Urban Development for district heating and cooling programs. The funds should be apportioned: \$8 million for DOE's Office of Building and Community Systems and \$2 million for technical assistance under the discretionary funds provided the HUD Assistant Secretary for Community Planning and Development.

WHAT IS DISTRICT HEATING AND COOLING?

District heating and cooling is a system of delivering hot or chilled water or steam from a central thermal source through pipes to customers for space heating and cooling and industrial process use. The central thermal source may be waste heat from an electric power plant or an industrial boiler. This technology is used widely in Western Europe including Denmark, Sweden, West Germany, and the Soviet bloc. Interestingly, district heating was invented in 1877 at Lockport, N.Y. by an independent American tinkerer, Birdsill Holley.

WHY DISTRICT HEATING AND COOLING?

District heating and cooling offers four major attractions:

1) District heating and cooling is fuel efficient. Electric power plants in the United States are on an average only about 33 percent efficient in producing electricity from fuel. Roughly two-thirds of the energy burned in our power plants is rejected as waste heat. In contrast a power plant connected with a district heating and cooling system achieves efficiencies as high as 80 percent.

2) District heating and cooling reduces the consumption of oil and natural gas. A district heating and cooling system has available to it a wide variety of fuel options which can replace individual oil and gas burners in residences, commercial buildings, and industrial facilities. In addition to waste heat, district heating and cooling systems can use coal and alternatives (for example: peat, municipal waste, or synfuels) to fire boilers to create hot or chilled water or steam. These are fuels which would be impractical

-more-

DISTRICT HEATING

WHEREAS, the American Public Power Association has previously supported the creation of a Federal program to provide grants to municipalities for testing the feasibility of municipal district heating systems and a revolving fund of low-interest loans to municipalities for the construction and refurbishment of municipal district heating systems, and

WHEREAS, Representative James L. Oberstar (D., Minn.), a consistent advocate of district heating, has introduced legislation (H.R. 3205) to provide for an accelerated program of assistance to small- or medium-size municipalities (municipalities with a population of one hundred thousand or less) for research and development and other assistance respecting district heating and cooling systems, which legislation authorizes funds for feasibility studies and creates a revolving fund for low-interest loans for construction or refurbishment of municipal district heating systems, and

WHEREAS, Representative Oberstar has also introduced legislation (H.R. 3204) which would create a residential energy tax credit and business investment tax credit for investments in certain property which will enable the taxpayer to use hot or cold water or steam provided by a district heating or cooling system which legislation would create a tax policy designed to stimulate development of district heating and cooling systems;

NOW, THEREFORE, BE IT RESOLVED: that the American Public Power Association commends Representative Oberstar for his leadership in seeking Federal programs to encourage the use of district heating and urges all Members of Congress to join with Representative Oberstar and enact H.R. 3205 and H.R. 3204.

—Resolution approved by the American Public Power Association at their Annual Conference in San Francisco, California, June 23, 1981.



RICHARD GORDON HATCHER
MAYOR

OFFICE OF THE MAYOR
GARY, INDIANA

TESTIMONY SUBMITTED TO THE HOUSE SUBCOMMITTEE
ON ENERGY DEVELOPMENT AND APPLICATION

JULY 23, 1981

The City of Gary, Indiana wishes to thank the House Subcommittee on Energy Development and Application for this opportunity to offer testimony regarding District Heating/Cooling's Potential and its Current Status.

The City of Gary views district heating/cooling systems as a partial potential solution to the energy problem in the United States. Yet this potential has not yet been fully recognized; and the governmental support of district heating systems is essential to the development of this energy system.

District heating is not a newly discovered process, but one which has been utilized to varying degrees in the United States since its development in 1877 and in Europe since 1893. It is defined as a process through which thermal energy is transported and distributed by a heat conducting fluid - usually steam or water - from a central source to serve the space and hot water needs of industrial, commercial, and residential users. The thermal energy transport medium which has traditionally been used in the United States is steam, while hot water is the transport medium which has been used in Europe.

Despite the long history of district heating useage in the United States, the current status of district heating/cooling systems in this country is discouraging. According to current statistics of the International District Heating Association, district heating supplies less than one percent of the total energy used in the United States. Recorded steam sales are declining. In 1980, steam sales were four percent lower than sales recorded in 1979 and 1979 sales were nine percent below the recorded 1978 sales levels. However, European countries are steadily increasing district heating useage.

Yet there is great potential for district heating in the United States. In 1980, the total energy used in the United States equaled 83 quads. (One quad equals 174.4 million barrels of oil). Of this total, approximately 20 percent or 17 quads of energy were used for space and hot water heating. Of this, approximately 8.5 quads could be supplied by district heating/cooling systems. In an era of increasing dependence on fossil fuel and rising utility costs, this statistic takes on even greater importance.

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In addition, district heating/cooling systems offers the following advantages.

1. The heat needed for a district heating/cooling system can be produced through "heat only" boilers or through a process called "cogeneration", the simultaneous production of electricity and thermal energy. In a cogeneration process, the waste heat is used for district heating. This process increases the fuel efficiency of 33 percent with 66 percent of the fuel being discharged as waste heat to a fuel efficiency between 60-80 percent with less than 40 percent of the fuel being "lost" as waste heat. (European systems have reported fuel efficiencies as high as 88 percent).
2. Reducing the amount of waste heat exhausted to the atmosphere will have positive environment benefits. The large amounts of water needed to cool waste heat would be reduced. Thus, thermal pollution can be reduced. In addition, small low level exhaust stacks can be eliminated which will help decrease low level pollution emissions.
3. A district heating/cooling system offers flexibility of fuel sources. Some of the sources of thermal energy that have been used in Europe to provide heat for district heating include: fossil fuels, refuse, industrial waste heat, geothermal sources and nuclear energy.
4. Since district heating/cooling systems can utilize waste heat, such as systems can provide space and hot water heating needs at a more stable cost than existing utility systems.
5. District heating/cooling systems which provide energy at a more stable cost can encourage economic growth - particularly in the denser urban centers of the northern part of the country which are heavily dependent on expensive fossil fuels for energy.

After considering these and other advantages of district/cooling systems, one must wonder what would be necessary to encourage municipal governments, utilities and other entities to utilize this energy system. Based upon our needs and information, the City of Gary respectfully makes the following recommendation for consideration by this subcommittee.

1. A coordinated national district heating program and plan must be formulated with input from Congress, the various appropriate governmental agencies, states and cities. Such a program should set goals and outline policies for district heating.

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2. A district heating information clearinghouse must be established to coordinate and disseminate information to municipal and state governments.
3. Congress must take an active role in establishing programs which further advance district heating. There must be funding in particular appropriate for feasibility studies as district heating is not widely known or understood in this country. For that reason, it is viewed as "risky" by the public. In addition, municipal governments do not typically have the funding available for the feasibility studies which are necessary for the planning of such a facility and the education of potential users.
4. Current incentives for district heating are centered around tax incentives. Municipal governments which could be the owners of district heating systems do not pay taxes and thus have no current fiscal incentives to develop the system.
5. Federal loan guarantee programs must also be established to aid financing of construction of district heating system as capital costs are very expensive and the return on investment will be negative for many years. In addition, private utility corporations are conservative groups which will not readily invest in "new technology" without government support and municipal governments are typically unable to finance large capital investments.
6. The federal government must also develop a program to sponsor additional demonstration projects. This will discriminate information on district heating and lessen the perceived risk held by potential investors.

Self-Reliance Inc.

July 16, 1981

Honorable Don Fuqua
Chairman
Subcommittee on Energy Development
and Applications
Committee on Science and Technology
U.S. Congress
Washington, DC 20515

Dear Mr. Chairman:

We would like to submit the following testimony concerning district heating to your Subcommittee. We hope that it will be considered along with the testimony presented during the hearing on July 23, 1981. As a brief introduction, we have been involved in district heating for a number of years. One of us (Geller) analyzed the technical and economic feasibility of residential district heating while at Princeton University. The other (Gleason) examined the prospects for solar district heating for the Solar Energy Research Institute. Recently, we formed the Self-Reliance District Heating Group, a research and consulting organization which is trying to help communities develop and implement district heating systems (see attachment).

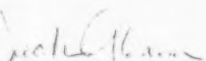
Based on our experience analyzing district heating and our familiarity with the developments in district heating worldwide, we believe that the federal government can greatly help to revive district heating in the U.S. and thereby foster urban renewal by actively supporting district heating and cooling (DHC) programs in the following five areas:

- o DHC systems based on renewable energy sources
- o The interrelation between end-use conservation and DHC
- o DHC systems using low temperature water as the distribution medium
- o Smaller-scale DHC systems for demonstration projects
- o Research and development on DHC technologies

We feel that these issues and activities have been underemphasized in the national DHC program so far. Our testimony briefly explains why we believe these issues are important and how they might be included as major components of the national DHC program.

Sincerely yours,


Howard Geller


Jack Gleason

TESTIMONY OF
HOWARD S. GELLER AND T.C. (JACK) GLEASON
SELF-RELIANCE DISTRICT HEATING GROUP

SUBMITTED TO THE
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
COMMITTEE ON SCIENCE AND TECHNOLOGY

JULY, 1981

We believe that five areas should receive greater emphasis in the national district heating and cooling (DHC) program. Our testimony addresses the opportunities in these areas and activities related to them which the government could undertake to encourage district heating on a commercial basis.

DHC systems based on renewable energy sources

In previous years, the national DHC program has emphasized district heating from coal-fired cogeneration plants. While this approach has its merits in terms of reducing oil and natural gas consumption, it does increase air pollution and other environmental problems. The use of renewable energy sources for DHC has the advantage of saving scarce and costly fuels without adversely affecting environmental quality. Unfortunately, renewable energy sources have not been a major element in the national DHC program.

There are a number of advantages to utilizing solar energy (and other renewable energy sources) in a district heating configuration rather than in a conventional on-site application. First, the high cost of solar

space heating (or cooling) can be brought down by taking advantage of economies of scale in heat (or cold) storage. Economies of scale result from both the surface area to volume effect for a storage tank and because potentially low cost collection and storage techniques such as solar ponds or the use of underground aquifers become available at a central site. In addition, interseasonal heat (or cold) storage is possible if the system is centralized. Interseasonal storage can lower the requirements and costs for collectors or cooling equipment.

The expanded potential for solar heating in urban areas is another advantage to district rather than on-site solar heating. On-site solar heating is limited in urban areas because of density, building orientation and high land cost. District heating makes it possible to collect and store solar heat on large plots of land in less densely populated areas where open land is both more available and less costly. Solar energy captured at the remote site could then be piped into urban areas.

Another advantage of solar district heating is that it permits the use of renewable energy technologies which are too complicated to use on-site. Photovoltaic cells with tracking concentrators is one such promising solar cogeneration technique. Renewable cooling technologies will probably have to be centralized to some extent as well. These technologies include solar powered absorption chillers and winter ice production along with interseasonal ice storage.

Sweden, a nation which utilizes district heating to satisfy about 30% of its residential and commercial heat needs, recognizes the potential for district heating using renewable energy sources. Sweden is engaged in research and development of innovative heat storage techniques for use in

solar district heating systems. The Swedish government has also supported two demonstration solar district heating systems each serving 50-60 buildings. Similar projects for clusters of 500 and 750 buildings are in the design stage. In addition, Sweden as well as Denmark have functioning and competitive district heating systems utilizing biomass as the heat source.

We recommend that the use of renewable energy sources be included as a major element in the national DHC program. The merits of renewable energy sources in general and the advantages of using these energy sources in a DHC mode rather than on-site should increase the attractiveness of the DHC program. Furthermore, the administration might be willing to support solar DHC since this technology, unlike on-site solar heating, is not yet commercial or near-commercial.

Specifically, we suggest that the federal government support demonstration DHC systems using renewable energy sources and provide technical and/or financial assistance to communities interested in establishing DHC systems using renewable energy sources. These activities should be coordinated with the renewable energy programs in DOE, SERI and other federal agencies. In fact, the DHC program might try to collaborate with ongoing renewable energy programs in areas such as solar ponds, aquifer storage, wind systems, and biomass utilization. The federal government could also get involved in DHC using renewable energy sources by participating in and supporting to a greater extent the solar district heating project organized by the International Energy Agency.

The interrelation between end-use energy conservation and DHC

Most energy analysts and planners now agree that energy conservation

should assume a much larger role in our energy economy than it has in the past. We are just beginning to implement the energy conservation measures which have become justified following the dramatic rise in the prices for oil, gas and electricity during the 1970's. District heating using power plant or industrial waste heat is an example of our untapped energy conservation potential.

The opportunity to supply heat through a DHC system will probably not alter the economic justification for significantly reducing heating and cooling demands in our buildings. However, the potential for end-use energy conservation has been neglected in most DHC studies in the past. This omission is regrettable first because energy planners may want to know whether an investment in a DHC system has a higher return than investments which lower heat demand. Furthermore, a DHC system could be a failure if it is designed and constructed for a heat demand which is substantially reduced due to the adoption of energy conservation measures within buildings.

The level of energy conservation in buildings can also effect the feasibility of DHC. In a study of DHC for new residential communities in New Jersey, one of the authors found that the cost of thermal distribution (\$ per unit of delivered heat) increased nearly two-thirds when annual heat demand is cut in half. In this case, the district heating network became more expensive as the conservation level in buildings increased because of a reduced capacity factor and because of the slow change in distribution cost with declining heat demand.

Adoption of energy conservation measures in buildings can also effect the cost for connecting existing buildings to a district heating system. In this case, lowering the heat demand at the same time a district heating

system is connected can lower the cost for converting the internal heat delivery system to district heat.

Thus, we recommend that a consideration of conservation in buildings be integrated into the national DHC program. Specifically, we suggest that DHC studies include an analysis of how much energy conservation in buildings is justified in conjunction with a proposed DHC system as well as an analysis of how end-use conservation effects the economics of a DHC proposal.

DHC systems using low temperature water as the distribution medium

Most major district heating systems in the U.S. are old and deteriorating steam systems in dense urban areas. In addition, some interest in medium and higher temperature (greater than 200°F) hot water systems is beginning. We believe, however, that there are major technical advantages to district heating with lower temperature (less than 200°F) water. This approach to district heating has been overlooked in the U.S.

One of the major attractions of DHC is that it can provide greatly increased flexibility in the choice of energy sources and conversion technologies compared to on-site heating. Heat source flexibility is maximized if a DHC system is designed to supply low temperature water. For example, low temperature systems can accommodate flat plate solar collectors or low quality waste heat. Furthermore, if low temperature water is supplied, the long-term commitment to a thermal distribution system does not necessarily imply a long-term commitment to a particular heat source. For example, if a DHC system initially utilizing coal-fired boilers or cogeneration plants supplies low temperature water, the DHC system can be converted to solar energy at a later time if centralized solar conversion and storage

technologies become viable.

One of the disadvantages of low temperature DHC systems is that larger pipes are required compared to higher temperature systems. We believe that this drawback is more than compensated for by the advantages of low temperature distribution. One of the main advantages is that it is possible to use pipes made of plastic, reinforced concrete, or asbestos-cement with low temperature water. These pipes are much easier to install and can cost less than half as much as metallic pipes (which are now necessary with water temperatures above 200°F). Furthermore, pipe insulation requirements and heat losses from the piping network are reduced if low temperature water is supplied.

The distribution of low temperature water is also preferable when district heating systems are connected to cogeneration plants. If a cogenerating steam turbine is used, the amount of electrical energy generated increases as the temperature of the district heating water decreases. In addition, the cost of a turbine retrofit for district heating can be minimized if very low temperature (120°F) water is utilized. If a diesel or Otto-cycle cogenerating engine is used, much of the recoverable heat is available at 200°F or less.

DHC systems supplying low temperature water may not be desirable in all cases. In systems serving industrial districts, process demands may necessitate supplying steam or higher temperature water. Low temperature water is most suitable in districts serving residential and commercial buildings. Sweden and Denmark are beginning to use low temperature systems in such areas. By doing this, they are able to extend district heating into neighborhoods once thought to have too low a heat demand density for district heating.

We urge the federal government to include low temperature water systems as a major component of the national DHC program. Specifically, we recommend support for feasibility studies and projects demonstrating low temperature DHC systems. Also, research is necessary to determine the lowest feasible water temperatures for space and hot water heating. This activity could be coordinated with DOE's active solar heating program since the same problem arises with the utilization of low temperature hot water from flat plate solar collectors.

Smaller-scale DHC systems for demonstration projects

The emphasis in the national DHC program on district heating systems using waste heat from existing power plants has led to large-scale demonstration projects. Demonstration hot water district heating systems in cities such as Minneapolis-St. Paul are estimated to cost on the order of \$100 million for systems serving urban core areas and on the order of \$1 billion for fully developed urban scale DHC systems. For smaller cities and towns such as Piqua, Ohio, demonstration district heating systems involving power plant retrofits are estimated to cost on the order of \$10 million in the early stages and up to \$100 million when completed. Prototype systems of this scale are difficult to finance and to "get in the ground".

There are compelling reasons for including or even favoring prototype DHC systems deployed on the block or neighborhood scale. Smaller systems are easier to finance, involve less risk, and can be designed and constructed faster than larger systems. Furthermore, more projects are possible if

each one is relatively small. Thus, the overall visibility of a demonstration program would be increased with smaller scale projects.

The institutional and regulatory barriers to DHC must be resolved for each application irregardless of system size. A larger number of small systems provides the opportunity to try a greater variety of institutional, financial and regulatory arrangements. This should accelerate the learning process in these areas.

From the technical and economic viewpoints, there are no penalties for installing a thermal distribution network which serves a block or neighborhood rather than an entire town or city. Furthermore, a larger number of small systems provides the opportunity to try different DHC sources including promising renewable energy technologies such as solar ponds or winter ice production and storage. In addition, it is still possible to use fossil fuel cogeneration plants in smaller-scale systems. In this case, it would be most practical to install a new cogenerating engine or turbine within or nearby the district. Such plants can be just as efficient and economical as cogeneration and district heating from an existing central power plant.

One of the primary goals of the DHC program has been to establish inaugural water DHC systems in order to stimulate water DHC in the U.S. Based on the arguments stated above, we urge the federal government to move ahead with block and neighborhood scale demonstration projects.

Research and development on DHC technologies

New equipment for thermal distribution and building interconnection have not been developed in this country because of the stagnating district

heating market. We now have the opportunity to duplicate the advances in DHC technologies made in Europe since 1945 as well as to make two breakthroughs of our own. This could significantly expand the potential for DHC and accelerate the implementation of water DHC systems.

We believe that a strong DHC research and development program could lead to advances in DHC technologies. For example, there is the potential to develop innovative water pipes made from materials such as fiberglass reinforced plastic or prestressed concrete. The DHC program could also support research on innovative DHC strategies such as routing pipes through basements and using very low temperature distribution water. In the area of heat sources, wind-driven heat pumps or wind-thermal systems deserve examination since there is a close coincidence between wind availability and heat demand. In addition, it may be useful to explore the potential for district cooling in greater depth and to support research and development on centralized cooling technologies.

A number of potential DHC sources are already under development in various branches of DOE. These include coal and biomass gasification, fluidized bed combustion, Stirling engines, fuel cells, renewable heating and cooling technologies and geothermal energy. In addition, there are federal programs to develop thermal storage technologies which can be used for DHC. The DHC program could collaborate with ongoing research and development efforts in these areas. In particular, it may be possible to demonstrate these technologies as part of a DHC system.

SELF-RELIANCE DISTRICT HEATING GROUP

Introduction

The distribution of heat from a central source via a piping system to a group of buildings, commonly referred to as district heating, has been practiced in the United States for more than a century. However, district heating is used only to a limited extent in this country today. Most existing American district heating systems are old and deteriorating steam systems serving very densely populated urban areas. In Europe, on the other hand, district heating using hot water has made great progress since 1945.

The success of district heating in Europe is partly the result of the advantages of district heating over on-site heating:

- **Greater heat source flexibility**—fuels such as coal and solid waste can be used and switched later
- **Greater fuel efficiency**—opportunity to cogenerate or to use waste heat
- **Greater cost savings**—opportunity to use relatively low cost fuels such as coal and to capture economies of scale in heat production and storage
- **Greater urban renewal opportunities**—potential to help revitalize a city by providing a relatively inexpensive and stable supply of heat

The use of hot water as the heat distribution medium is another important reason for the success of district heating in Europe. Hot water has the following advantages over steam as a heat distribution medium:

- Lower capital and maintenance costs
- Ability to transport heat over longer distances
- Increased efficiency for cogeneration units producing low temperature hot water

The increasing cost of oil and natural gas coupled with the advances in district heating technology have created conditions very favorable to the development of district heating systems in American communities.

The Self-Reliance District Heating Group has been formed to help communities develop and implement hot water district heating systems. The group is based at Self-Reliance, Inc., a consulting firm specializing in community development through the utilization of local resources. SRDHG consists of specialists in the areas of district heating system design and analysis, cogeneration, innovative district heating technologies, economic assessment, community energy planning and energy project finance.

The Approach

SRDHG believes that a truly comprehensive perspective is required to plan and implement a district heating system. The specialists at SRDHG will analyze all aspects of a community's potential to utilize district heating including:

- End use considerations
- Distribution systems
- Heat sources
- Economic, institutional and planning issues

A. END USE CONSIDERATIONS

It is important to implement conservation in buildings along with the installation of a district heating system so that the system is not oversized or underutilized. SRDHG can determine the most cost-effective level of energy conservation in buildings in conjunction with a particular district heating scheme. SRDHG will then determine the aggregate service area heat demand.

Another end use problem is the interconnection between the district heating system and the heat delivery system already present in buildings. SRDHG is prepared to analyze the interconnection requirements and, if necessary, design the most cost-effective modifications for the internal heat delivery system.

B. DISTRIBUTION SYSTEMS

The distribution network can be the most costly component of a district heating system. The high capital cost, long distribution system lifetime and the difficulty of altering the system following installation make it very important to design the distribution system properly. In analyzing and designing the distribution system for a community, SRDHG will perform the following tasks:

- Determine the optimal route
- Determine the optimal temperature and pressure for distribution water
- Size and select the least costly pipe and insulation
- Size and select other components such as pumps, valves, heat exchangers and heat meters
- Design systems that provide chilled water for space cooling as well as hot water for heating

MEMBERS OF THE SELF-RELIANCE DISTRICT HEATING GROUP

The Engineering Team

PENTTI J. AALTO B.S., Engineering, Antioch College, 1970. Ten years experience in cogeneration, district heating, energy conservation and heat recovery analysis and system design. Chairman of the Board, Massachusetts Bay Chapter, New England Solar Energy Association; Staff Engineer, Governor's Commission on Cogeneration (Mass.); Member, Public Utilities Regulatory Policies Act Rates Task Force, American Public Power Association; Integrated District Heating/Heat Recovery Study for Dartmouth College; Cogeneration feasibility study, Rockland, Mass. Public School Department. Relevant report: "Preliminary Design of a Cogeneration/District Heating System for Manchester" (a neighborhood in Pittsburgh) for the Institute for Local Self-Reliance, 1980.

HOWARD S. GELLER B.A., Physics, Clark University, 1977, M.S.E., Mechanical and Aerospace Engineering, Princeton University, 1979. Three years experience in district heating, cogeneration, energy conservation, and renewable energy technology research and analysis. Analyzed the technical and economic feasibility of district heating for residential communities in New Jersey. Fulbright-Hays scholar researching renewable energy resources in India, 1979-80. Research and consulting work performed for: U.S. Department of Energy and the Institute for Local Self-Reliance, Washington, D.C. Relevant publication: "Thermal Distribution Systems and Residential District Heating," Report 97, Center for Energy and Environmental Studies, Princeton University, August, 1980.

THEODORE B. TAYLOR B.S., Physics, California Institute of Technology, 1945, Ph.D., Theoretical Physics, Cornell University, 1953. Thirty years experience in the energy field and ten years experience in research, development, and demonstration of a wide range of renewable energy technologies. President of the Appropriate Solar Technology Institute, Damascus, Md. Worked on an assessment of the potential for energy conservation and renewable energy utilization through community action in Damascus, Md. Designed and tested ice production and storage systems for district cooling or the cooling of commercial buildings.

Relevant consulting work performed for: Ford Foundation, Rockefeller Foundation, U.S. Congress Office of Technology Assessment, and the Prudential Insurance Company. Relevant publications include: "The Prospects for World Wide Use of Solar Energy," report to the Rockefeller Foundation, 1979; and "Low Cost Solar Energy," chapter in *Nuclear Energy and Alternatives*, Kadiroglu, et al., (eds.), 1978.

ROBERT W. TIMMERMAN, P.E. B.S., M.E., Mechanical Engineering, Cornell University, 1965, 1966, Ph.D. candidate, University of Pennsylvania. Twelve years experience in power plant, cogeneration, district heating, solid waste-to-energy, and HVAC systems design and analysis. Holds three patents on power plant waste heat utilization and heat pump technologies. Designed the first project in which power plant waste heat is used for heating a commercial building for the Massachusetts Municipal Wholesale Electric Co. Feasibility study of cogeneration for Rockland, Mass. Public School Department. Consulting work performed for: Argonne National Laboratory, Stone and Webster, United Engineers, R.W. Beck and Associates, and various electrical utilities. Relevant publications include: "Utilization of Power Plant Waste Heat for Heating," *Heating, Piping and Air Conditioning*, 1978.

The Economic, Institutional and Planning Analysis Team

T.C. (JACK) GLEASON A.B., Fairfield University, 1970, M.U.P., Environmental and Energy Planning, New York University, 1976. Five years experience in environmental and energy planning, international energy policy and solar district heating research. District heating consulting work performed for Friends of the Earth/U.K., the U.S. Solar Energy Research Institute's (SERI) New England Sustainable Energy Project and the Center for Renewable Resources Solar Cities Project. Relevant reports and publications include: "Planning for Energy Conservation and Solar Energy Utilization" (graduate thesis); "District Heating Saves Energy (In Europe)," *Public Power*, Sept.-Oct. 1979; and "Efficient Fossil and Solar District Heating Systems Report" to SERI (in progress).

Furthermore, SRDHG will incorporate the latest developments in distribution systems, including low cost piping technologies and lower water temperatures.

C. HEAT SOURCES

The next major component of a district heating system is the heat source. SRDHG will design, evaluate and compare the following central heat sources:

- Fossil fuel boilers
- Industrial waste heat
- Refuse incineration
- Cogeneration from existing power stations
- Cogeneration using smaller-scale turbines or diesel engines
- Fluidized bed combustion
- Gasification of solid fuels
- Solar energy, biomass or other renewable energy sources
- Heat pumps
- Geothermal energy sources

SRDHG can analyze and design diurnal or interseasonal hot water storage facilities for application with virtually any heat source. The group is prepared to investigate the feasibility of a number of energy sources and technologies for the provision of district cooling including absorption chillers, winter ice production and interseasonal ice storage.

Our approach to waste utilization involves source separation and utilization of part of the waste stream for heat and part for recycling and composting. This approach simplifies the technical problems often encountered in waste combustion. By reducing the waste stream through recycling and composting, cities also decrease the size and capital requirements for heat recovery plants. Furthermore, resource recovery provides the opportunity to develop local industries that can recycle materials into valuable and highly marketable products.

SRDHG believes that it is important to design a district heating system so that it can easily utilize a variety of heat sources. This flexibility permits the system to adapt readily to advances in heating technologies and changes in fuel costs. For example, a system can be designed to use fossil fuel initially and then switch to solar energy at a later time. SRDHG is prepared to incorporate the provisions necessary for heat source flexibility into a district heating system.

D. ECONOMIC, INSTITUTIONAL AND PLANNING ISSUES

The feasibility of a district heating system design depends to a great extent on cost considerations. SRDHG will carry out the following economic analyses:

- Integrate the individual technical components into the most cost-effective system for a particular application
- Evaluate the economics of a proposed district heating system based on ownership by a municipal utility, an investor-owned utility or private sector ownership
- Compare the cost of district heating to the cost of saving heat through conservation and to the cost of supplying heat on-site through conventional methods

SRDHG will also examine the following financial issues, which are critical to the development of a district heating system:

- Land use plans
- Building codes
- Local utility regulations
- Environmental impacts

In summary, SRDHG has the skills and the experience to design and evaluate the most efficient and least costly district heating systems possible today. We feel confident that our comprehensive approach to district heating can help communities achieve a much brighter energy and economic future.

Background

SRDHG is the newest division of Self-Reliance, Inc., a consulting firm established in 1979 to foster community development through local resource utilization. Self-Reliance specializes in assisting businesses, municipalities, community groups and state government agencies in areas such as economic development, municipal waste utilization, utility economics, energy project finance and community energy planning. In 1980, Self-Reliance analyzed the technical and economic feasibility of district heating for a Pittsburgh neighborhood. Clients served by members of Self-Reliance, Inc. include the World Bank, the U.S. Department of Energy, the U.S. Environmental Protection Agency, the State of Nebraska, Atlantic County, N.J., Kent County, Mich., Washington, D.C., Baltimore, Md., Fresno, Calif., the National Science Foundation, and Carnegie-Mellon University.

The Self-Reliance District Heating Group is composed of nine specialists organized into teams in the following three areas:

- Systems Engineering
- Economic, Institutional and Planning Analysis
- Waste Utilization

In addition, a number of other specialists in related fields are on call to SRDHG if their services are needed.

JOHN PLUNKETT Studied economics at Georgetown University and Swarthmore College. Staff economist, Institute for Local Self-Reliance. Three years experience in utility economics and financing, economic feasibility analysis, and the economic and regulatory aspects of cogeneration and district heating. Economic feasibility evaluation of district heating options considered in a conceptual engineering analysis for a neighborhood in Pittsburgh. Relevant publications: "Planning for Energy Self-Reliance: A Case Study of the District of Columbia," Institute for Local Self-Reliance, 1979; "Facing the Grid: Utility Economics and Alternative Energy Planning," *New Shelter*, April 1981; "Municipalities and the Public Utilities Regulatory Policies Act, Section 210: Opportunities for Local Revenue Generation" for HUD, 1981.

DAVID MORRIS B.S., Cornell University; M.A., University of Florida; Ph.D. Urban Planning, Union Graduate School, 1977. Seven years experience in community energy planning, economic development planning, energy-related financing and research in a wide range of energy technologies. Founder and President, Institute for Local Self-Reliance. Columnist, *Solar Age* magazine. Relevant publications and reports: *Neighborhood Power: The New Localism*, Beacon Press, 1975; "Cellulose Insulation Manufacturing as a Community-Based Economic Enterprise" for U.S. Community Services Administration, 1978; "Municipal Energy Independence," *Energy and Cities*, American Institute of Architects Research Corporation, 1978; "Planning for Energy Self-Reliance: A Case Study of the District of Columbia" for the U.S. Department of Energy, 1979; and "Economic Development and Financing Mechanisms Associated with Energy Conservation in the Manchester Neighborhood of Pittsburgh" for Carnegie-Mellon University, 1980.

The Waste Utilization Team

JON GARCIA HULS B.A., California State University, Dominguez Hills, 1976, M.S. candidate, Environmental Engineering, California State University, Long Beach. Seven years experience in solid waste management and resource recovery system research, analysis and design. Founding member, California Resource Recovery Association and former Editor-in-chief, *Resource News*. Consulting work performed for: the U.S. Environmental Protection Agency, the World Bank, Atlantic County, N.J., Philadelphia, Pa., the State of Nebraska, and numerous California cities and counties. Relevant report: "Technical Assistance for an Environmental Assessment of the U.S. Department of Energy's Integrated Community Energy System Program" for Argonne National Laboratory.

NEIL SELDMAN B.S., Industrial and Labor Relations, Cornell University, 1966, M.A., Ph.D., George Washington University, 1974. Seven years relevant experience in waste utilization policy and resource recovery system design. Director of the Institute for Local Self-Reliance, Washington, D.C. Founder of the Committee for a National Recycling Policy. Relevant consulting work performed for: The World Bank, U.S. Department of Energy, U.S. Department of Commerce, National Center for Appropriate Technology, the state of Nebraska, Atlantic County, N.J., Kent County, Mich., Philadelphia, Pa., and other cities and communities. Relevant publications include: *Neighborhood Based Recycling: A Community Action Guide*, Civic Action Institute, 1979, *Municipal Composting: Guide for Municipal Officials and Community Organizations*, Institute for Local Self-Reliance, 1980.

For further information, contact Jack Gleason at SRDHG, 1717 18th St. NW, Washington DC 20009 202/232-4108.

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1717 18th Street NW
Washington DC 20009
202/232-4108